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From Research to Reality

A Retrospective on the Development and Acquisition of Naval Capabilities During the Cold War Era

Transcript of a Seminar Held at the Naval Postgraduate School 12 and 13 June 2001

by

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27 July 2005

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From Research to Reality

A Retrospective on the Development and Acquisition of Naval Capabilities During the Cold War Era

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The meetings were held at the Naval Postgraduate School, and the hospitality of RADM David R. Ellison, USN, NPS Superintendent, and of numerous members of the NPS professional and support staff are gratefully acknowledged.

The theme of the meeting grew out of discussions among Dr. James Colvard, Dr. Phil DePoy, and Dr. Walter LaBerge. Dr. Colvard also served as moderator during the meeting.

Lastly, thanks are due to Judy Daniel, who cheerfully took on the onerous task of transcribing these proceedings from the video tapes.

INTRODUCTION

The 200-year plus history of the U.S. Navy is a proud story of battles fought and won, of outstanding leaders afloat and ashore, and of selfless service to our Nation.

Equally important, it is a story of the continuing application of new technology to the advancement of naval capabilities. From smooth-bore guns to submarine-launched ballistic missiles, from sextants to satellite navigation, from sail to steam to nuclear propulsion, the Navy's progress has been measured by the introduction of technological innovation.

Perhaps at no other period in this history has the adoption of new technology in the Navy been as pronounced and effective as during the Cold War in the fifty or so years following the end of World War II. This technology led, for example, to strategic submarines; submarine-launched ballistic missiles; an entire family of air-launched weapons, and, more recently, the AEGIS system. The difficulties encountered in developing these systems were formidable, and the conceptual, technological, and engineering advances necessary to bring them to fruition were remarkable, even by today's standards. Safe, reliable nuclear propulsion for submarines; long-range missiles launched into exo-atmospheric trajectories from beneath the surface of the seas; missiles fired from high-speed aircraft, with the self-contained capability to home in on other high-speed aircraft; shipboard weapon control systems simultaneously detecting, tracking, and coordinating hundreds of airborne targets. None of these would have been thought possible a generation ago. With respect to the research, development, and introduction of weapons and combat systems, this was the most productive period in Navy history.

Why was the Navy able to make such advances? What were the circumstances that led to such remarkable achievements? How were the resources of the Navy brought to bear on the operational and technical problems of the day? These questions deserve to be examined, in order that an historical picture of the Navy's experiences be captured and recorded.

One way to assess any aspect of Navy history is to seek out those were a part of that history and to solicit their views and experiences. This approach represents the basis for the present report.

An earlier report on this symposium was published as *From Research to Reality*, NPS Report No. NPS-IDSEA-02-001 of March 2002.

BACKGROUND

The Naval Postgraduate School identified a group of individuals who, during the period of interest, had key roles in the development of technology and in its application to naval capabilities. They were carefully selected both individually and collectively; i.e. each had had substantial duties in a particular area of expertise, and together they represented a wide range of responsibilities across both the spectrum of research, development, engineering, and system acquisition as well as within the Naval community. They are listed below, along with their major affiliations pertinent to the time period being examined.

Dr. Alan Berman (Director, Naval Research Laboratory)
Dr. James E. Colvard (Technical Director, Naval Surface Warfare Center/Dahlgren)
Dr. Phil DePoy (President, Center for Naval Analyses)
VADM James H. Doyle Jr., USN(ret) (Deputy Chief of Naval Operations for Surface Warfare)
Mr. Ralph E. Hawes (General Manager, Pomona Division/General Dynamics)
Dr. Alexander Kossiakoff (Director, Johns Hopkins University Applied Physics Laboratory)
Dr. Walter LaBerge (Technical Director, Naval Weapons Center/China Lake)
VADM Paul F. McCarthy, USN(ret) (Director, RDT&E, Office of the CNO)
RADM Wayne E. Meyer, USN(ret) (AEGIS Program Manager)

The group encompassed the entire process from ideation and discovery through putting a combatant to sea; thus the Labs/R&D Centers, OPNAV sponsors, SYSCOM Program Managers, fleet operations analysis organizations, and private industry were included.

All of these individuals expressed an interest in the subject and a willingness to meet together for discussions of their respective experiences and contributions. (Dr. Kossiakoff participated in the discussions via teleconferencing.)

The object of this meeting was to record the personal views of some of the people who played key roles in the systems development and acquisition process during the time period in question. They were a collection of officers and civilians who managed the programs and directed the institutions that produced these systems. There is no record of such a group having been previously assembled for this purpose.

In advance of the meeting, which was held on 12 and 13 June 2001 at the Naval Postgraduate School, each participant was provided with some explanatory

material, topics for discussion, and questions to address. Participants were asked to focus on what they did and why they did it during their years of having accountable responsibility in the R&D and acquisition process. Their views of what worked and what didn't was to be considered particularly important. Comparisons of their experiences with today's environment were to be avoided, as this should be left to future historians.

Suggested topics included:

- -Resources
- -Staffing
- -Management structures
- -Key players

Questions posed to stimulate the thinking of the participants included:

- -What were the key things that allowed your organization to be successful?
- -Who were the key players you dealt with; who did you try to avoid?
- -What competition did you face?
- -What obstacles did you have to overcome?
- -What institutions helped you the most and which hindered you the most?
- -Where did you go for help?
- -What irritated you the most and what elated you the most?
- -Who did you consider the honest brokers in your arena?
- -Were there conflicts between institutional leaders and program leaders?
- -How much time did you spend seeking resources?

The meeting started with each participant individually describing his experiences in the R&D and acquisition world as he was involved in it. These individual presentations then formed the basis for a subsequent roundtable discussion among all the participants to determine whether common themes and threads could be discerned from the earlier presentations. The intent was to have a freewheeling discussion among a group of people who were key players during the Navy's most active period of combat systems acquisition in order that this experience could be captured for its historical value. The sessions were video-taped and transcribed; the transcription follows.

INDIVIDUAL OBSERVATIONS

DR. COLVARD: "The focus for today and tomorrow, and particularly today, is to capture the experiences that we all had as responsible people in the R&D and acquisition process during what we call the Cold War Era. This morning, each of you will have up to thirty minutes to talk about your experiences, what you saw, what worked, what didn't work. This afternoon we will discuss as a group the ideas that came out this morning.

"Everybody at the table has a long and distinguished resume. If I only read the parts that are true, it would take all morning. And so I will introduce each person very, very briefly, and when we publish the report, a more complete resume will be included.

"First, we have Dr. Alan Berman, whose background is in the research end of the R&D spectrum. He was the Director of the Naval Research Laboratory for a number of years, and is widely viewed as having been a preeminent leader in Navy research. Dr. Berman."

DR. BERMAN: "The period I'd like to discuss in my life was roughly from 1957 to 1982. During that time, I had responsibility for two organizations. One was what we nowadays call a Federal Contract Research Center, which no longer exists, and the other one is, as Jim said, NRL. And I'd like to discuss four projects that I've worked on because they're illustrative of what contributed to success and what contributed to failure. In the course of my life I was remarkably fortunate. I was in organizations that had extremely good support of the senior leadership in the Department of Defense. There is obviously a fair amount of idiocy when we go into any civil service system. Suddenly you find you're about to lose the best and the brightest of your engineers because you can't promote them to a GS-13, because there's a ceiling on the number of GS-13s you can have.

"But neglecting the sort of inanities that go with government institutional life, it's your job as a director to make it work. I did have, in general, an extremely fortunate situation because we were supported very well by ONR. By that, I mean, the labs at NRL and the Hudson labs, which I ran before, had significant amounts of 6.1 funding, and they benefited from the results of ONR's research program. And one could then be in a position of some leadership of putting together programs of things that we needed.

"Now, let me start with talking about the development of underwater surveillance, which was a major program in the '50s and '60s and so on. As we all recall, in the 1950s the Soviet Union, which was our prime adversary in the Cold War, had lots of submarines. The numbers went down as they couldn't maintain their force

level. But they were really very poorly built, extremely noisy, and quite easy to detect by passive means. With time it was clear they were getting quieter until they got so quiet that most of the work we did was no longer terribly useful.

"But in the era in which it was useful, the development was fairly interesting. The United States started to worry about the Soviet submarines very actively around 1952. And what was desired was a broad area surveillance system that allowed submarines to be tracked. There were roughly three things you can do: You can track a submarine with another submarine -- one-on-one engagements had some disadvantages but it certainly was done. You might, if you were lucky, set up barriers with sonobuoys, whether it was P-3 aircraft or various derivatives, or you could have some sort of area surveillance.

"The Navy approached the problem in three ways. One was passive, one was active, the other was nonacoustic. What was done in nonacoustic was very interesting. It's still classified, and whatever success it had was driven by the Assistant Secretary of the Navy, at the time, Dave Mann. What he insisted on was a true knowledge of phenomena and a true understanding of how to conduct tests. And he ran a rigorous program in which NRL was but one of several performing activities. And he coordinated things, and he managed with extremely good leadership and very, very high professional standards. And whatever success that program had, came from that. In the passive area, the success that the United States had was a function of drawing on a broad laboratory infrastructure of many organizations. Things of the scale of putting in a SOSUS system could not and did not happen because of any single organization. That is, lots of organizations claim that they were responsible for it, but the success we had there was a result of advances in signal processing, understanding of long-range acoustic propagation, better knowledge of the symmetry that we had, the instrumentation capability, and so forth.

"And above all it was a function of having one man, Joe Kelley, who ran the project from the time he was an O-3 until he was an O-6, roughly 20 years later. One man drove the entire project for the entire time. There was continuity. Obviously, he made some mistakes, but he drew on a very broad base of research and development. You had people at Western Electric who first put down remarkably primitive cables that looked about the size of a cross-section of an elephant's leg and eventually ended up with fiber optics with all of elegance associated with it.

"What is more interesting, to my mind, is to talk about a project that I was associated with. In fact, I was the de facto leader of a project that failed, and that was active underwater surveillance. And it was interesting to go through the question as to why it failed. The project set out to build an active underwater acoustics submarine detection system that had a range of 500 miles. We started in 1957, and it probably died of its own weight about 1967, just as I left to take on NRL.

"The point was that this project failed for a number of reasons. If one went through the sonar equation, for the case of the 500-mile detection, we discovered we knew just about nothing. We did not know propagation well enough. We did not know the physics of acoustics absorption. We did not have, at the time, the technological capability to do the signal processing. You actually needed a computer that operated at a rate of about one megahertz, which would bring a giggle out of any teen-aged child today. But in 1957, being able to do that seemed like a heroic, unattainable goal, though technology would eventually advance, and we could do it.

"But the point is that this was a project that started out with a poor knowledge of the environment and the physics of the problem with inadequate technology to support it, and worse than that, it was conceptually poor. It was much too easily countermeasured or destroyed. Nevertheless, the problem was not that we didn't have resources, that we didn't have support, and that we didn't have every member in the community join in to support and work on it. The problem was that it was ill-conceived from the beginning. And that's one thing one always has to remember; that an awful lot of programs ought to be looked at in the sense of whether the technology is at hand or can be reasonably extrapolated.

"We had an IBM 702 computer. I don't know if any of you remember it. But it took several rooms this size to put it in. And it had a thoughput of about one millionth of my laptop that I carry around nowadays. It's sort of hard to project back to trying to do a system where, indeed, you needed the signal processing strength that is trivial now but was unattainable then.

"It also failed in technology in other ways, but at that point needed a high transducer gain. And what we did was to design a transducer that weighed 450 tons, and we cut a World War II "T" tanker in half, put a big moon pool down, and could lower this thing to 1800 feet below the surface.

"Well, that raised questions of how you stabilize an 18-thousand-ton ship in a seaway with something of 400 hundred tons dragging below it and so on. We didn't understand the dynamics and never did solve most of those problems. And there are some problems that, in fact, the Department of Defense took on which did not fail for what I would call administrative reasons or silliness; they failed because of inherent lack of knowledge.

"One of the interesting programs that NRL was involved in was the development of GPS. That, too, had a remarkable history, and it really began back, in some sense, when I was a graduate student. I got out of the Army after World War II and went to graduate school. And after my GI Bill of Rights ran out, my professor said 'Isn't the GI Bill money running out?' I said, 'Yes.' He said, 'What are you going to do?' And I said, 'I'll give up eating.' And he said, 'Well, there's this funny organization from the Navy that's just starting up that's called the Office of

Naval Research and they would like to fund you.' Well, gee, that was good, clean fun. 'And what do they want to fund me for?' 'Well, they would like you to build a time standard for their first clock.' In fact, this object is in the Smithsonian. I remember years later taking my youngest child there. We looked at it in amazement. He said, 'Gee, Daddy, that must be an olden times time standard.'

"But the point is that there was a history of the development of time standards. Clocks went from rubidium/cesium/molecular beam machines to fairly compact, well-developed things and eventually to hydrogen masers that were stabilized. And the work was done under ONR contract at various universities around the world and at NRL. And at NRL, you had a group of people who were familiar with the problem of navigation, who had a long history of having developed navigation devices, and who were interested in putting this capability into space.

"That program went along and had its ups and downs, but gradually became more and more successful. There were many things wrong with it. One was the downlink. And fortunately a man named Phil Diamond, at Aerospace Corporation in Los Angeles, built an ingenious system for using it at the L-1 or L-2 channels, as opposed to the rather strange system the Russians put forward in their time standard.

"And the third thing was that microelectronic receivers came along and were developed so that it became a truly viable system. What is sort of interesting about that, in your gouge sheet, Jim, you asked to identify bad guys. I remember that we were at a DSARC meeting to decide whether to go ahead with this. And the Navy representative was one Admiral Harold D. Shear, who some of you may remember. And Hal Shear had a lot to do with my life.

"He was a sort of guy where you could hear waves crashing over the fo'c's'le when he spoke. And we went around the table. 'What does this service think?' 'What does that service think?' And he, as the senior Navy representative said, 'The Navy has no use for this system.' We can navigate, we have SINS for our submarines, we have sextants, and some places we actually had LORAN-A.'

"So I thought that was the end of the program. But sitting on the back benches there was a one-star Air Force officer, who rather shyly raised his hand and said, 'Well, the Air Force is sort of interested in this for navigation of aircraft.' And they decided to make the Air Force the lead, which was probably a very fine decision, allowing as how the system had no significant backing in the Navy. There was a lack of people in the Navy that understood at the time what the impact of the GPS-like system would be on the Navy and the whole rest of the world – on weapons, weapon systems, weapon-delivery accuracy.

"Again, as I said, the strength of GPS and the ability for it to happen depended on a lot of things, many, many organizations, and many people. The

development of atomic resonant time standards probably laid the foundation, for without it you could not have gotten there; without the rather brilliant work from Aerospace Corp., you couldn't have got there; and without the major developments of receiving technology. Above all, without the refinements in the birds that have actually been put up in the air, the power, the agility, the bandwidth, the orientation stability. There were many, many factors. Government labs and associated organizations played a huge role in it. Navy Basic Research funding played a basic role in it.

"And the point is that it is a system that initiated probably from about 1971 or 1972, if memory serves me right, or at least that's when the Hal Shear rejected it. And after thirty years, it is still being developed, still evolving, still getting funded for various things. There are still warts and pimples on the GPS system. There are certainly warts and pimples on the service's dependence on GPS for weapon delivery and that sort of thing. But what is the success story is that here is continuous funding, a general acceptance, and continuity. The technology was there. The understanding of the physics was there. And a lot of talented people were available. Those were the ingredients for success.

"Another program that NRL had a major role is in various aspects of overhead surveillance. These programs are still, obviously, highly classified, and it's difficult to talk about them in total.

"The question is: How did they come about in the first place and where did the technology come from? Quite interestingly, in that case the technology came from NRL-based original satellite programs, which were oriented to scientific research. There was a group led by Herb Friedman, a fairly fancy astronomer and sensor man, who liked the idea of being able to put sensors above the earth's atmosphere, and gee whiz, look at all the things you could see.

"The program obviously outgrew NRL. Half of it split off and went to some organization that began to be called NASA. And the other half sort of stayed at NRL, but basically worked in those days for NSA. It was a fairly easy step that you if can put a sensor with a scientific payload up, you can put a sensor with a collection payload up.

"The collection payloads became fairly interesting. Their conflict in that development was basically between NSA, a technical intelligence agency for collection and support of military operations, and NASA. An overhead sensor is very important for military operations if and only if it satisfies things like providing ID, providing localization with precision, and doing it without any latency.

"Now, in the early designs of these systems the idea was that everything would be shipped back from wherever it was downlinked and sent back to Fort Meade. And day workers would come in on eight-hour shifts once a day and work on it, and three to five weeks after the fact, they would catalog something, and this

would be distributed, mostly at a highly-classified level, but certainly no operational commander was terribly familiar with it.

"There were three programs; NRL ran one of them. To force it to much lower latency, greater accuracy, geolocation, and much faster and better and more effective ID so that it could eventually become a component of a targeting system, was where the battles were. That battle is, in some sense, still going on, quite amazingly, although the program was taken over many years ago by NRO, the National Reconnaissance Organization, and it is much more rational than it was in my era.

"The question of whether or not you were ending up with a collection system or a tactical detection system is still being resolved. Though the battle is almost over, I would think that in any real sense NRO's future is in tactical support of targeting. But it is interesting that that was successful in that the program was based on existing technology and its extension. It was based on investing lots and lots of money in it; there was no money limitation. And it was based on having availability of an interaction with industry, which was very real and one could support very significantly.

"I can go over one other thing, and I will leave it at that. The lesson in the other one is what is called NAVSPASUR. We have in the United States a tracking system that is operated by CINCSPACE which tracks all objects in space, to a first approximation. What it amounts to is a line of bi-static radars across the southern part of the United States starting somewhere in South Georgia and extending west to California.

"Basically, this started out from the first attempts of NRL to build a satellite tracking system from the very early days of NRL's satellite experience. They discovered that tracking something this big 5,000 miles away, when you did the radar equation, didn't work very well. And that the only real hope you had was to do forward scatter.

"And this was eventually institutionalized. It was a system that was heroic by the proportions and context of what people had done previously. It did not require much besides good contractors to literally build the transmitters. And receivers required a lot of real estate because these receivers were big. And it required a fair amount of processing. And by the time NAVSPASUR was completed in, oh, 1971 or 1972, you already could do things, like ten-megahertz processing rates. You began to do quite well.

"It was turned over and was operated by folks down in Dahlgren, and it worked very well. It is a component of CINCSPACE's responsibilities. As the years have gone by, the number of objects in space has sort of gone up exponentially. Of course, an 'object' includes a satellite that has broken up into little splinters and dust and things of this sort. Again, it is being improved in the form of upgrading

the power of data processing through receivers and so forth and better displays and better cataloging and better computation of Newtonian dynamics of what the orbitology should be.

"The point I make here is that there was a willingness to use an unconventional form of radar and to base a major national system on it. Getting that accepted was not a trivial thing to do. And one can be quite amazed that a system like that, that was dependent on what was a concept that was in the physics textbooks books by 1850, was still not accepted in a more general sense into the 1960's.

"Nevertheless, it was built. And again, there was a steady use, and there was feedback, as problems developed, by operators who were operating the system, using it on a day-to-day basis. It's a system that is now operated and manned twenty-four hours a day, seven days a week. As problems develop, contractors take care of it and do the additional work. And, again, it was government laboratories that had the continuity with it that has made a difference. And contractors that have had the continuity with it have made a very significant difference. And I think at that point I will stop."

DR. COLVARD: "Our next participant is Dr. Phil DePoy, who spent much of his career as a scientist at sea. He was the Director of the Operations Evaluation Group, and later was president of the Center for Naval Analyses. He can discuss the use of Naval systems from the operator's perspective."

DR. DePOY: "Well, I'm not going to talk for my full thirty minutes, because I don't think studies and analysis played that much of a role in R&D and acquisition during the period of interest.

"But there is one area in which studies did play a major role in acquisition in the 1960's. In that period we had a series, most of you remember, of very major systems analysis studies in almost every warfare area. They were conducted at CNA, but they were chaired, always, by Navy captains, almost all of whom went on to be three or four star flag officers, and, I think, at least three went on to be CNO. Very capable people were chairing the studies! We brought in a lot of people from the labs and from industry and from the Navy. These were very large operations; I think most of them had a hundred or more people, and they lasted for a fair length of time. At the time I didn't really appreciate the value of those studies. I must say the quality of analysis in them was spotty. But I didn't appreciate the value and impact of the dialog that went on during this period, basically among industry, the labs, and the Navy.

"And looking back on that period, I think the quality of requirements for systems was much better because of those systems analysis studies and also because the technical capabilities of many people in what are now the Systems Commands was much higher than in more recent times. And I hope that at some

point in this meeting Paul [McCarthy] and Ralph [Hawes] and others talk to this point. I have heard Paul talk about the quality of requirements in recent years. But I think those very large studies of the 1960's played a major role in establishing requirements for the next decade or so.

"Let me speak now about operational analysis. I was director of OEG [Operations Evaluation Group] for ten years, five of which I reported to Admiral Doyle, who was OP-03 for the longest time, I think, of anyone in history. OEG reported in those days to OP-03 because 03 had previously been the DCNO for Fleet Operations and Readiness before it became Surface Warfare. In the role of measuring capabilities of systems in the fleet, I think OEG, at least some of the OEG analysts, made major contributions which influenced requirements for follow-on systems. By the way, I always felt that eighty percent of the analysts in OEG were analysts you could get from anywhere. But there was always ten to twenty percent that were exceptional. And I always believe that the price of CNA was paid by that ten to twenty percent.

"And OEG analysts had made significant contributions to system requirement formulation since early in World War II. Looking back over the history, a large fraction of the contributions which influenced requirements was in ASW, which is why OEG was established in the first place. The original group that was formed as ASWORG [Antisubmarine Warfare Operations Research Group] in 1942 were mostly physicists from MIT and even in that group, I think it was still the ten-to-twenty percent that were truly exceptional people. And in Vietnam when new weaponry was introduced, I think it was important to have analysts on the scene to analyze as best we could, the effectiveness and shortfalls during the early stages of their employment.

"My greatest concern during that period and during the '80s was that after the Cold War ended, it was going to be very difficult to attract good people to the business. It was easy to attract them in the early days. OEG was part of MIT until 1962. Our advertisements for new people used to have MIT in big block letters and underneath it in little tiny letters that said, 'You will go to Washington and the fleet.'

"But it was easy to attract people because it had some excitement about it, traveling around the world, being with the Navy and the Marines. And I think most of all, there was a very great relationship between the Navy and OEG. I suspect if the organization hadn't been formed in World War II, it never could have happened.

"It was counter to the Navy's culture to accept civilians in the operational forces, but even though the Navy resisted it in the first place, it soon was accepted. Because of this great relationship, it was easy to attract people and, more importantly, to retain them. Analysts joined OEG, intending to stay only for a few years, and then got hooked on it. Many good scientists tried it for a little while

and liked it, being out in the fleet and that sort of thing, and stayed with it for long times, sometimes their whole careers.

"But I was very concerned in the '80s. After the Cold War ended I feared that it was going to be very difficult to attract good people. And, again, I wasn't worried about the eighty percent. I was more worried about hiring the ten-to-twenty percent at the top of the heap. I was president of CNA during that period, and I negotiated a deal with Carl Trost, the CNO, and with Jim Busey, who had moved over to FAA, that CNA would start supporting FAA. We hoped it might be easier to attract people if we had something other than just the defense work

"Looking back on it now and having some contacts with CNA over the last ten years, I must say I don't think it occurred. I think that they have been able to attract the same quality. And I think it's still in the few-percent category, the top. CNA has hired some people that are really exceptional over the past few years. I've always considered that CNA's top few percent would rank with the top anyplace. I spent the last eight years at the University of Chicago, and I felt those top few percent at CNA would rank with the top few percent there, as well as most other similar schools.

"So I don't think the problem that I thought would occur, has occurred. I think the best are still there. They're still attracted to the defense business, just like the high quality of people entering the service academies. It may be even better than it's been in other periods of time. And so that problem just never developed.

DR. COLVARD: "Did you have any experiences when you were out riding the Navy combatants, reflecting the accommodation between the culture of the military and the culture of the civilian scientist? You probably spent more time in that interface than anyone else."

DR. DePOY: "I mentioned the relationship between the analysts and officers in the operating forces. Not too long after I joined OEG, I guess, maybe four years after I joined, I was sent out to WESTPAC. And I was there during the start of the Vietnam War. I then went over to the Med during the Mid-East War in '67 and then went back out to WESTPAC toward the end of the Vietnam War and spent a lot of time.

"The relationship I talked about is best characterized, I think, by a flag officer who is still living so I won't mention by name. We were in his flag mess one night at dinner in a carrier off Vietnam, and he was complaining about the attitudes of civilians. He included everyone, all living civilians, in that group. He obviously didn't think there was anyone in the whole lot that amounted to much. And finally one of the wise Commanders on the staff spoke up and said, 'Well, Admiral, Phil's a civilian.' And he responded very gruffly said, 'He is not!' So that ended the discussion.

"But we were treated remarkably; at that age, my late 20s, I was given roles that I can't imagine ever having anywhere else. As an example, at one time we were planning the first very early strikes into Laos. It was very closely held. We were down in the South China Sea, but this was before the war really kicked off. CINCPACFLT scheduled a meeting in Yokosuka for his deputy and Commander Seventh Fleet to meet with CTF 77. CTF 77 decided at the last minute that he couldn't leave the Fleet, so he sent me to represent him."

RADM MEYER: "Well, didn't John Lehman finally square away that organization, CNA?"

DR. DePOY: "Yes, he certainly squared me away."

RADM MEYER: "That's the way I recall it."

DR. DePOY: "Despite all that was said about John Lehman, he frequently asked us to do studies directly for him, but he never put pressure on us to come to a specific answer. I can't say the same about some of his assistant secretaries. As an example of the type of thing he asked us to do, was a study of his proposed strategic homeporting plan, i.e. of stationing the ships in the U.S. all over the place, so the Navy would have a larger base of support."

VADM McCARTHY: "Universal support?"

DR. DePOY: "Yes. So he called me over and assigned us the task of studying strategic homeporting. He didn't say what the outcome was supposed to be, but it was pretty obvious what he would like it to be. So we did a study. And it was very critical of the whole concept. We had a policy, and we stuck to it: everything we did, when we finished, was distributed. But some things were distributed less widely than others. And so for this study, we sent a copy to the CNO, the VCNO, and OP-090 – perhaps few others, maybe a dozen copies. And of course, one went to the Secretary. I waited anxiously for his response and thought I would get to see how he fired people, as was the belief throughout the building. The next day we had a CEB, a CNO Executive Board, and he was in there for some reason. When he stood up to leave, he turned and said, 'Phil, would you stop by my office when you leave?' The CNO and other attendees thought this was great fun, and told me good-bye. When I went into his office, he gave me something else he wanted us to look at. I saw our study lying on his desk when I went in. He never mentioned it, so I said, 'I thought you wanted to talk about our study'. And he said, 'Oh, hell. You guys never did learn how to do studies.' And that's all he ever said. I know he didn't like some of our work, but, unlike some of his assistants, he never criticized us directly."

DR. COLVARD: "We'll hear now from Vice Admiral James Doyle, who was the Deputy Chief of Naval Operations for Surface Warfare, OP-03, and who held that position longer than anyone else. He was also Commander of the Third Fleet, so he brings us a perspective of both the operational Navy and the Washington Navy. Admiral Doyle."

VADM DOYLE: "One of the benefits of getting older is that you're always meeting new people. The other advantage is you're able to recall vividly events that never actually occurred. But I'll try to stick to the facts.

"I'd like to focus on the five years from 1975 to 1980, when I was the DCNO for Surface Warfare, then called OP-03. And that responsibility actually involved all things related to surface warfare and surface ships; that is, the plans, the programs, and the budgets.

"At that time, we still had the nuclear surface ships: the LONG BEACH, BAINBRIDGE, TRUXTON, CALIFORNIA, SOUTH CAROLINA, and the VIRGINIA class. And the SPRUANCE 963, the PERRY FFG-7, the AEGIS cruisers and destroyers – TICONDEROGA, the CG-47, and the ARLEIGH BURKE, which I'll talk about later -- the LHA-1 TARAWA class. the LSD's, the new AOE, an AO, the hydrofoil PF, the air cushion landing craft, and the maritime preposition ships -- all of those were, in some form or another, under my sponsorship during that period. And it was my responsibility, also, to testify on Capitol Hill as to all the ship programs; that is, the aircraft carriers, surface ships, and submarines. Of course I would take over with me OP-05 and OP-02. It was great at that time. I really enjoyed taking Bob Long, who was senior to me and who later became Vice Chief. But I was in control of that particular hearing, so that was fine.

"There were also a number of programs, specific programs, which I was involved in during that period: TOMAHAWK, HARPOON, the eight-inch major-caliber lightweight gun (until it was arbitrarily and capriciously canceled by OSD along with the eight-inch guided projectile program) -- also the LAMPS-3 SH-60. And we were still involved with the SH-2, the LAMPS-1.

"And then along came vertical launch and the SQR-19 towed array, the SQS-]23 sonar, which later became the 51 series, the Mark 46 lightweight torpedo, the rebuilding of the SPS-48 in terms of the new threat upgrade, CIWS/PHALANX, NATO SEASPARRROW/RAM, the SLQ-32 design-to-cost ECM system (to replace the WLR-1), and the Battle Group AAW, which interestingly enough is the forerunner of CEC. (We wouldn't have a CEC today if it hadn't been started by that program and carried on by the Applied Physics Laboratory.) And finally and very significantly AEGIS and Standard Missile--I'll say more about that. I was also involved in the surface warfare training and qualifications. As you know, we changed over from fleet readiness. We had an OP-03, a community. And the person who was in my position was the recognized leader of that

community, so I had to pull together the training and the qualifications that had to do with surface warfare, and I had to do this despite CNET. I just mention that casually.

"Also I established surface warfare policies and studies and analysis. It all matters. Of course, one of the problems is with all those things you've got to establish priorities, but you also had to keep the various programs in balance.

"Now, to get to the bottom line, which you wanted me to discuss here in terms of what helped me, what hindered me, et cetera. What helped me the most was tenure. I was there for five years, so I had continuity. And I saw a lot of people come and go, particularly at the political level, and I outlasted a lot of people. So that was to some advantage.

"I also had three stars. And I was on a level playing field with OP-02, 094, 098, and 04. And I really want to stress this, particularly 090, because 090 was the final arbiter of resources and so forth. We worked very closely with the CNO. And so we had an organization, which was very streamlined and very flat; in other words, I had direct access to the CNO. And if I didn't like something 090 was doing, I could go directly to the CNO, and we could have it out. Sometimes I'd win; sometimes I'd lose. But the point is that I had access at that level.

"In this regard, it helped on the Hill to have three stars, and it helped in the building with OSD and sometimes with ASN(R&D). I'm not sure how much. But it was interesting that I read recently that Rumsfeld turned in his one star for three stars, so that tells you something. Also I just mentioned direct access to the CNO, Vice Chief, ASN(R&D), OSD, CNM, NAVSEA, NAVAIR, and NAVELEX. I felt that I could deal with them, if I had something to deal about.

"And then the greatest relationship, of course, when we started the AEGIS program was with Admiral Meyer, PMS-400. I should also mention OEG because Phil and I had a very good relationship. I believe that times you [Phil] were under fire by the parent organization, and we had to do something about that. And I had access and worked directly with the laboratories.

"It was important on the Hill that I was recognized as the shipbuilding spokesman. When I talk about 'I', I don't mean that I did all this. I'm talking about my staff, really. I had a great staff. Three of the officers I managed to get into OP-03 had been my executive officer and two of my department heads on BAINBRIDGE. So they were well known to me. One of them, Admiral Hoss Miller, became the AEGIS coordinator when we established that billet within OP-03; he worked directly with PME-400.

"But I also had Jack Shaw, and Gil Guilbault. Bill Rowden was my deputy, John Nyquist was my EA, and Verne Clark was my aide. So you couldn't get much

stronger than that. And then Hank Mustin and Bruce Miller rounded that out. Now, let me go into some of the interesting things which occurred.

"When I reported in, in 1975, I think I was there a couple of weeks when I was summoned by the CNO, Admiral Holloway, to his office. And he said, 'I'd like you to go down and explain to the Secretary of Defense Schlesinger why we have over 1.1 billion dollars in shipbuilding claims.' And I said, 'Well, are you going to be out of town?' So I called over Admiral Gooding, and he and I went down and tried to explain the inexplicable to Secretary Schlesinger.

"And I got a rude introduction into total package procurement; the McNamara concept of how to formulate concept definition and contract formulation. That is, basically, the principle of turning over to a contractor a general performance specification and then establishing share lines and arbitrary schedules. So the plan is to try to build a ship that's got changes when you don't have specific enough requirements; the contractor really doesn't have an engineering requirement that can be translated into engineering specifications to go on, so there are changes that have to be made.

"Well, every time you have to make a change because either the threat changes or something in the design just doesn't work, you've got a claim. Lawyers get into the act, and you get claims and requests for equitable adjustments. Of course, the Navy decided to settle those claims years later; Secretary Hidalgo finally settled those claims, and the Navy paid out large sums of money. In the meantime, it seemed to me obvious that there had to be something better in acquisition than relying on total package procurement. In one ship we had to change out the propulsion system because it just wasn't working. That's one example.

"The next thing that was interesting was the fallout from the Major Fleet Escort Study. You recall the Major Fleet Escort Study was done to simulate a general war with the Soviet Union, and particularly how were you going to get the supplies across, et cetera. And out of that came the requirements for the number of ships. For example, the DXG, that turned into the 963 and not a 'G' at all, but a single-mission ASW ship. And the FFG-7, which was designed to-cost, was supposed to come in at $60 million. It never did. The 963 was supposed to come in at $85 million. It never did. They were single-mission ships. They were introduced to the fleet without complete weapon systems -- with just space and weight. They had problems.

"John Buckley used to live next door to me down at the Navy yard. And he'd come back from an inspection trip about eleven o'clock or twelve o'clock at night and carrying some article from the ship he'd just inspected, and open the door and say, 'Well, here's what I found on one of your ships', and he would tell me this horror story of what was going on.

"In any event, we had problems with the waste heat boilers. We had problems with 400-cycle power. We had problems with the propellers on the 963. The Mk 86 system couldn't track. The Mk 92 system wasn't working. There was a whole string of problems that occurred during this time. And all these ships during that period eventually had to be accepted with a waiver. Eventually, we did try to re-arm the ships as time went on, but it cost millions of dollars to do this catch-up work, and we were still stuck in some sense with single-mission ships.

"Well, getting back to priorities, it seems to me in looking over the various priorities and trying to keep everything in balance, that it was very important to get the AEGIS system to sea as soon as possible. So that became my number one priority. So we started what I think was a textbook illustration of a team effort among OPNAV and PMS-400 and the Applied Physics Laboratory and other laboratories and contractors trying to get AEGIS to sea.

"Of course, we had several aborted attempts. And Admiral Meyer, I'm sure, will give us more detail. But there was the LONG BEACH possibility. The CNO had recommended that we build eight CGN strike cruisers and sixteen DDG-47s. And we had a problem with Title 8 and Admiral Rickover insisting that all ships be nuclear-powered. I think it was 1977 when there were no warships in the budget because of a failure to come to agreement between the House and the Senate. Finally, we got that turned around and got agreement that the TICONDEROGA, the CG-47, would be authorized and appropriated.

"Let me just say that in the introduction of that ship, several things influenced my behavior, and one of them was my nuclear power experience. I had been through the first refueling of BAINBRIDGE at Mare Island. And the follow-up procedures and so forth you have to go through. And after you're finished, you're certifying the crew is qualified to light off the plant. And it could only be done by ship's force.

"Contractors weren't allowed to touch the plant. That was the number one rule. The ship's forces operate the plant. My thought was, and Admiral Meyer and I agreed on this, that in the introduction of the CG-47, the check out of equipment for the weapon system ought to be all completed, in addition to the propulsion plant as well, with ship's force.

"So I initiated correspondence with BUPERS and finally got agreement with the Vice Chief, who signed out a memorandum and authorized that. So we started, I think, for the first time in the acquisition of non-nuclear ships a procedure that the crew would report aboard in plenty of time to check out and be trained and qualified. Of course they had gone through CSEDS, the Combat Systems Engineering Development Site at Moorestown, with all the training, and they would have been the only ones to operate the equipment.

"I had been a task group commander aboard two carriers in the Mediterranean in 1973 and 1974. And in Third Fleet in 1974, it became obvious to me that there's got to be a better way for air-battle management. So while I was at Third Fleet I initiated a TACMEMO that set up the CWC, the Cordinated Warfare Commander, which parceled out the job of Anti-air Warfare Commander and ASW Cmmander; the AAW Commander would be parceled out to the CO of the missile ship, because he had the experience and it just could not be done aboard the carrier, either from the expertise or the displays. Displays were still a problem, but primarily because of the lack of expertise. And ASW was parceled out to either the CO or the squadron commander. And sometimes the ASWC was resident onboard a 963, or sometimes he would be a squadron commander placed aboard the carrier and he would be there directing the ASW action.

"So this is just a good example of the cooperation we had and how we worked together. So my staff and Admiral Meyer's staff got together at the Applied Physics Laboratory and actually laid out the CIC. I mean, we determined that there would be four large-screen displays and where they would be located and postulated who they would be used by and what kind of displays they would be and how they would accommodate a flag officer, if he was aboard, so everybody could see the displays. So my experience in the battle group certainly influenced my behavior.

"Now, in terms of the AEGIS system, that I'm sure that Admiral Meyer just can't wait to talk about: You know, we talk about transformation these days. And the real transformation in acquisition took place under Admiral Meyer's dynamic leadership. I mean, this was a transformation in organization, acquisition, fleet introduction, shore-based training, and infrastructure, land-based prototype, engineering support, manning and billet structure, and new concepts of ship integration and system engineering. You know, as he puts it, there was an evolution of some 20 years of 'build a little, test a little'.

"And so that was really a transformation that just revolutionized the way we introduced surface ships. Rather than just having the situation where the hull, mechanical, and electrical people were the designers who would design the ship, and the shipbuilder would build the ship -- and all of a sudden one day at the pier here comes the delivery of the combat systems to be put aboard, and you hoped to hell it would work. And so that transformation was done.

"Now, this didn't come about easily. A lot of blood and sweat went with it. I remember particularly there was a year there -- there may have been more -- but for about a year the there was a DDG-47 manager, PMS-389, and there was an AEGIS PMS-403, and nothing was happening. So Admiral Meyer and I both approached the Chief of Naval Material.

"Here's a good point: we had a Chief of Naval Material that we could go to. And he authorized a study, or directed a study, to be made by a flag officer, Ed Ott, I

believe, did that study and reported back that, 'Hey, you've got to combine. You've got to create PMS-400. We've got to get on with it. You've got to integrate the combat systems and the ship.'

"Now, first, a lot of these weapons systems I mentioned earlier that were worked on. Some of them eventually got into the fleet in one form or another and were successful. Some we're still working on. But it's interesting in the case of TOMAHAWK. We were told by OSD/PA&E that 'new surface ships don't need TOMAHAWK. There's no reason to have a TOMAHAWK because you have a HARPOON.' Well, as you know, HARPOON is only good against other ships. And they just could not see a TOMAHAWK at all.

"It was obvious that we needed to keep the AEGIS line going, not only the TICONDEROGA class, but also we needed a new destroyer. So again, there was the simplicity of the organization that allowed me to go directly to the CNO, not through anybody else, with a tasker to task me to do a study on what the destroyer should be. The words in the tasker were 'Battle Group capable'. That was the criterion: 'Battle Group capable'.

"So we formed the study. Admiral Meyer supplied Admiral Roane, I believe, at that time. And my people and a number of lab people were involved, and they went off to White Oak for a year and did the study and came back. And they compared all the various systems in AAW particularly against what we had and said, 'Well, it's got to have AEGIS aboard -- AEGIS based on AEGIS technology.'

"We also made a pitch in the study, in the analysis, to use TOMAHAWK. Actually, we played TOMAHAWK in the analysis, and, interestingly, we used it in the initial phases of some scenario. I have forgotten what it was, Vladivostok or wherever, but we programmed the TOMAHAWK's in the study against the air defense sites. And we proved, on paper, that if you did that, that the follow-on aircraft strikes would suffer less attrition.

"Of course, when we got that resolved we had all sorts of skeptics. PA&E didn't believe that at all. And so forth and so on. In any event, we reported out the study to the CNO. And I was told, initially, that, 'We're not going to build AEGIS. We're never going to build AEGIS. We're not going to build an AEGIS destroyer. They're too expensive. They're too vulnerable', et cetera, et cetera. 'Over my dead body will we build it.' Well, fortunately, nobody had to die, and in the ensuing fray we persevered and our successors persevered. And now how many AEGIS ships are in commission?"

RADM MEYER: "There are fifty-eight now in commission: twenty-seven cruisers and thirty-one destroyers. And about ten years' worth of ships are on the building ways right now".

VADM DOYLE: "So much for the predictions these people have made about what you can build".

DR. COLVARD: "Let's switch now from the government to the private sector that is the arena where the results of R&D efforts actually get built. Ralph Hawes has probably had more experience in the missile world, helping to build the surface Navy, than anyone. He was Vice President and General Manager of General Dynamics' Valley Systems Division in Pomona and then an Executive Vice President of General Dynamics. So he was responsible for producing the Navy's surface-launched weapons. Mr. Hawes".

MR. HAWES: "I'm going to talk a very narrow spectrum from the industrial point of view, and that is the spectrum of one division of General Dynamics. And I, too, responded to Jim Colvard's memory-jogger list, or set of questions he put out. I have selected four that I'll talk to.

"The first question I wanted to respond to that he had on there, which I thought was a very good one: 'What were the key things that allowed you and your organization to be successful?'

"So I'm going to talk a little bit in that regard to the organization itself, recognizing that the organization is a collection of people. And it is people who fundamentally get things done. And the second point, if I get a chance will be to talk about: 'What are the obstacles that we had to overcome in being successful?' And then third, 'Where do you go for help?' Which I thought was a very interesting one because none of us in organizations of people get things done generally all by ourselves. We get it done because we have help. And then the fourth one would be: 'What institutions helped you the most and what hindered you the most?'

"Those are the four points that I'm going to I'll try and cover. I'm going do it without going in depth on any one, more in a bullet or a point or concept form, which will give us plenty of opportunity later in the day to talk about them. So let's talk about the key things that allowed success. And here's about eight of them, not necessarily in any priority order.

"General Dynamics Division. I came onboard in 1956, which was about four years after the division was born. I think 1952 was the birth year. And I stayed until about three years before the death of the organization. So I wasn't quite at the birth but also wasn't quite at the death. I look at it that I was really at the golden years of that particular division.

"The first one was the challenge of missilery. So missilery was something new. It attracted the youngest and brightest and most eager of the engineers that were really still coming out of the era of the GI Bill and World War II. So it attracted

large numbers of very bright people, most of whom, by the way, had a service background, or many of them did.

"They had an experience base that many of the young engineers coming out of the academic community do not have today. And that created a very different environment with the young engineers who were going into an organization like the Pomona Division.

"My second point is there was a national priority on defense systems. What we were doing was important, nationally. It wasn't so much as a business or money, because a lot of us down in the organization knew that we were doing something of national importance. Of course, a lot of that was driven by the fact that we had a more coherent threat at that time called the Russian bear.

"At Pomona, we knew who we were. We were Navy, all right. It was a 'Naval Industrial Reserve Ordnance Plant', had that on the sign, operated for years by General Dynamics. So there was role and mission clarity. It was very clear what we were all about.

"Initially, we were the production facility. We weren't even the engineering facility. The engineering facility was APL. Now, that didn't it very well with the young Turks who came down from Convair because, remember, this was a spin-off from Convair.

"And one of the things that Wayne knows plagued us for years is that the youngest and brightest were in engineering. The old tin-benders were over in production. And that led to a lot of engineering-to-production transition problems, but that's a minor point that I wanted to make. So we knew who we were. We knew what our role was. And we had young, bright engineers to get on with it.

"Another fundamentally important thing was that the funds for R&D, what we call IRAD and B&P, were overhead allowable. It was not a call on profits, it was an allowable expense, and whatever we could convince the government to fund us, we could get. And when I ran engineering, as an example, I ran that small operation with over $20 million a year in IRAD and B&P. So we weren't like a pharmaceutical company or anything else. For R&D, it was recognized that that was a legitimate cost of doing business. It was important for the perpetuation of what the Navy was trying to do. So we had a constant source of money that came in to support work on the research side.

"Another very important point about this little division was that our corporation was a defense company. General Dynamics was primarily a defense company. We had people at the senior-most levels that were oriented in defense: airplanes, submarines, tanks, things that were unique. Something on the order of eighty-five percent of the business, maybe even higher than that when General Dynamics was at its peak, was all defense related. And that will be

important when I later talk a little bit about where we went for help. That was not the case with a lot of other companies that were a part of General Motors, or a part of Ford, or someplace else. We were a defense corporation, and the Pomona division was a defense oriented division within that defense company.

"The sixth point is that in that division your career path was technical and program management. If you wanted to get anyplace in that company, there were certain chairs that you'd better occupy and go through. But they were all fundamentally technical and program management in their nature. So our higher level was not staffed by people that came out of the financial side until much later in General Dynamics' career or came out of the marketing side, which was what often happened at Ford Aerospace. You had to come up through the technical side.

"During my ten years as General Manager I never had a Program Manager who was not a technically-trained man. Why? Very simple! Technical people make better technical decisions on programs than somebody out of a financial community or somebody that came out of a marketing community or whatever else makes up a large business enterprise.

"The division was also blessed with excellent Navy leadership. Now, what do I mean by that? Well, if he wasn't the first, he was pretty close. The first General Manager was a retired Navy Admiral, Charley Horne. He set the tone for the organization when these young Turks that were coming out of Convair as to what the division was all about. He used to start his all-hands meetings without using a microphone or anything. He would blare out, 'NOW HEAR THIS!' And that's the way the meetings got started.

"Well, that inculcates within people a certain attitude. And when you went into that plant originally, everything was gray. We had gray tile on the floor; we had gray desks. Man, it was Navy. When you walked in, you were in a Navy facility. And that's what we were all about.

"We had excellent NPRs, Navy Plant Representatives. And in later years it became very obvious that was not by happenstance. Wayne [Meyer] had an awful lot to do with it. I'm sure that some of his predecessors, perhaps, involved themselves in that. But we had experienced career officers, rotating through, who lived with us, padded around our halls, came into my office, whether I was a Program Manager or an engineer or the General Manager, anytime they wanted, every day. And they wore their uniforms.

"Again, the importance for identification of what it was that we were all about. We were blessed with very spotty Program Managers in the total sense of the programs that we had, which what you might expect. The peak of that, for that organization, was the AEGIS program; the leadership of the AEGIS program, the

continuity of the AEGIS program, and what it did for the organization. We knew how important we were in what we were doing.

"During my tenure also, particularly in the early years, the agency roles, the labs, field organizations, and Program Officers had clearly-defined roles and generally lived within them. And APL had an awful lot to do with setting that in the early phases. And we didn't have, until the later years, very much conflict between what we were all about, what the other agencies were all about. Save one to talk about later, save one, NWC/China Lake. And there were reasons for that.

"So we knew where we were. We had very supportive agencies. We recognized our roles, particularly the APL role, and we worked strongly with it. Now, as we matured and we grew up, we tended to drift away from that. We tended to get out of our sandbox a little bit, more than just missilery. But, again, as far as I'm concerned that's a fairly minor point on what made that organization successful. So there are about eight points that say why I think that organization was very successful.

"Let me turn to point two, the chief obstacles. One of them was in the technical arena: the lack of computing power in the early phases. I can remember people working Freidan calculators and doing a lot of the calculations. The development of component reliability and how to achieve it was one of the technical problems. Modeling and simulation was a totally new field that we did a lot of the pioneering in, to be able to model it beforehand, test it, not only on the laboratory floor, but test it in-flight. We were constantly updating those models.

"The development of a very complex engineering system process was another challenge. When Pomona was first generated, it didn't know system engineering from diddly-squat. But over the years we matured that. AEGIS was the highlight of bringing that into being. Unfortunately, there was not a good way to capture that, other than with people, so in later years it tended to evaporate, particularly when the company was acquired. Another technical obstacle was instrumentation, the emerging sophistication and the capital intensity of the instrumentation, whether it was in the production testing or whether it was in field testing. Those are some of the technical arenas that were obstacles that we overcame to get on with ever increasingly sophisticated missiles.

"When you look at that division, the '50s were the age of rocketry, the '60s were probably the age of guidance, the '70s were probably the age of accuracy and guidance, and the '80s were probably the era of systems integration of that particular sophisticated weaponry.

"A second obstacle was this production transition that I talked about. A lot of that was people-oriented. And here I'm talking about moving from onezies and twozies in the engineering phase to where you had to produce a large number of them, a reliable number of them to go into the fleet. So you had to tear it out of

the engineer's hands, get it in the production guy's hands, and when you did that, at least in the early phases, you were giving it to a bunch of tin-benders who really didn't understand electronics. And, of course, our drawings were never perfect, so we had all kinds of problems."

VADM McCARTHY: "They were going to make it anyway."

MR. HAWES: "Yeah. Well, I can remember some arguments over a table like this where Cy Sylvester, I'm sure you remember him, got up on the end of the table (Cy was only about five foot two) and walked across it. Howard Saunders was sitting down here, and he's about six foot three. And so he took his shoes off, walked across the table, and told him how screwed up the engineering was.

"Well, Howard did very well in solving that problem. He just took a bunch of us engineers and shipped us out to the production floor, and we lived out on the production floor for months and months until we got it squared away. With that was the demise of the tin-benders in production. Within a matter of a year or eighteen months, they were all gone. Engineers came over and started learning about production and running production. The production transition was one of the chief obstacles, and we learned how to get around it the hard way.

"Another obstacle was flight testing and proofing the systems. I've spent a lot of time, a lot of you did, out in the field learning what flight testing was all about; the instrumentation, the inadequacies and the sophistication that we finally evolved, the telemetry and the importance of telemetry, its development and it's reliability, particularly in multichannel. The whole process of simulating what you were going to do in-flight and doing it in-flight and getting that data and coming back and updating the simulations so next time around you can do a better job of what deciding what it was you needed to do in the missile, instead of having a pilot onboard in order to make that thing fly right.

"So it was a whole process of integrating and flight testing, instrumentation and flight testing, getting it back into the engineering side, so that you knew what you had so you could simulate what you had, not only from an engineering point of view, but to know what you needed to do from your production tolerance point of view, to get something out in the fleet that eventually would get up to over eighty-percent, ninety percent reliability of a missile when you put it together.

"And the final point as far as chief obstacles we had to overcome was building a tolerance for flight failure. Particularly in the early days, it was not an assured outcome. What you had to do, you had to learn to communicate with nontechnical leadership. And I'm talking about at all levels. We were fortunate at the corporate level; I didn't have to worry about that because of the technical people that I had, including Dave Lewis, who was the CEO at that time. But within the Congress, within the customer arena, you had to learn how to communicate engineering, from a technical point of view, with non-technical

people. We had to do that. They weren't going to learn from us. We had to do that as the engineering personnel, how to communicate with others.

"We had to learn to not oversell. One of the propensities of engineers is to oversell. They're always optimistic, and you want them to be optimistic. But the death knell is if you didn't communicate very well and you oversold, the next time you went in there to see that congressional staffer, he was going to cut you off, not at the knees, but at the belt because of what you did.

"So learning and evolving over a period of time, being able to tolerate failures in-flight was an obstacle that we had overcome, and we didn't do that overnight. It's taken a lot of time and a lot of work in order to do that.

"Another obstacle was maintaining adequate funding, a stream of funding. This is very important from the standpoint of program continuity. Every program that we had at that division that got in trouble, it generally wasn't for a technical problem, it was the vagaries of the funding level. You were constantly adjusting schedules. You were constantly adjusting the technical requirements within it, and this was exacerbated when we didn't have assurance of a reasonable stream of funding.

"We had annual budget battles that we had to go through within the programs we had at the division. But we knew we could count on the continuity of the funding of the AEGIS program. We didn't know that on PHALANX. We didn't know that on that RAM. We didn't know that on some of the other systems we built.

"But the Program Office, PMS-400 in this case, understood that one of their roles was to work on that side of it. If we got into trouble and we needed more money on that particular program, there was a thing called a Program Priorities Review. It was not only held with just the division and the funds we had, but leadership. PMS-400 did it on a very broad scale within their total project. So that funding stream was very important.

"Another obstacle that we had to overcome was the rollover of service Program Managers. The Navy was pretty good in this regard, particularly in the later years with Meyer onboard. The Army was the worst. You know, every two years on the REDEYE and STINGER program, I had a new Program Manager that we had to educate, work with, and learn how to work with, and that rollover was hooked to their tour of duty. The Army studied it and studied it and talked about it; the Navy did it, to a great degree. Even within the PHALANX program, we had pretty good tours of duty and tenures of our Program Managers.

"I can't stress how important that is, that concept of the tenure in a given spot, at least over the phase. If you had a four-year engineering development period, it would be nice to have your Program Manager there for that four years. If you had an eight-year-production phase, it would be nice to have your Program

Manager there for the eight years, but we could handle four. So that hooking of the tenure of the Program Manager to the phase of the program for continuity is very, very important.

"The last point I'll talk about, and this evolved throughout the period that I was there, was the changing business expectations. Early on, the expectations were not as high on the financial return side as they became later. And the corporate and shareholder demand for increasing returns started creeping into the operation as the industry matured and the division matured, with increasing competition for programs and more companies chasing fewer programs. Therefore, the demand for research money, the demand for capital for the things that you needed to go out and produce the weapon system, for the capital intensity of engineering and production. So the whole business structure started to change. And I'm going to guess it started to change in the '60s and '70s, probably in the '70s.

"One element, one action really brought that to bear, and that was the 'second source' drive that John Lehman placed on industry. It fundamentally changed the economics of the division and eventually led to the demise of that division. Because new corporate fathers came in who had different thrusts; specifically, one, relative to the return out of the programs said, 'If you can't be number one in that business or if you can't guarantee a return on asset hurdle rate of about twenty percent, get the hell out of the business.'

"And that's what General Dynamics did because they couldn't guarantee that. And it was brought on by Lehman's second source thrust. Now, that may have benefited the Navy, may have benefited the nation, I'm not going to argue that point. I'm saying it was a fundamental shift in the economics of the business because you could never justify the front-end investment that took you twenty years to recover.

"Where do you go for help? Of course, this depends upon your position in the leadership profile of the company or the agency. I want to talk to you from a Program Manager position. Where do you go for help? First thing you went to your mentors for help. Now, in the Division we were very, very lucky that they had excellent mentors. Bill Morrals started that division, for instance, in engineering. Even to a certain extent the Charlie Hornes that represented the general management at that time. The George Burkheimers who represented the research side of that part of the equation.

"When any of us young Program Managers got in trouble, we could go to our mentor, and we could get advice and counsel on what to do. If you had a mentor on the Service side, you could go to that individual to get some help. In Pomona there was a very strong Navy bond that permitted us to go in and close the door, with some of our Navy counterparts, whether it was a particular NPR or a

particular Program Manager, like PMS-400. You can get some mentoring there as well. So that's one of the first things that you did; you went to your mentors.

"Second, you went to your sponsors and supporters, wherever they were on our program. But you had to work and develop a cadre of those that you could go to. And all the experienced PM's knew how to do that. That's why one of the things that we did within our division was develop Program Managers, because they just don't happen, you have to develop them. We started them out running small programs or working them into a small element of a big program, and then gradually rotate them around, whether they went back to engineering and then into program management or out into production. We had a regular way that we tried to develop our Program Managers, so the time we turned over a Standard Missile or turned over a PHALANX or turned over a RAM system to a Program Manager, they knew the ropes. They pretty well knew how to get help when they needed help.

"You could also go to your sponsors and the congressional staffers, and in the early phases we did have some. One who comes to mind is Tony Battista. He could be a devil, but by the same token, if you got Tony on your side and you kept him well-communicated with and well-informed and you allowed him to participate a little bit in the program management, Tony could be one of your biggest and best supporters.

"We searched out the technologists within the DOD community and we'd use them. Let me give you a good example, not on a Navy program but on an Army program. We had a system that we called REDEYE, eventually STINGER.

"I used to get Jim Ambrose, the Assistant Secretary, to come out and visit us. Some days I just got a call that said, 'Ralph, I want to come out to see what's going on, on that two-color system.' The next thing I know, he'd show up on my doorstep, and he didn't want a slide presentation. Jim Ambrose wanted to go into the engineering lab or walk onto the production floor and see what was going on. Jim Ambrose was a supporter. And I knew I could go to Jim Ambrose for help on a program if I needed it.

"The other thing we did was we developed laboratory ownership, and that's where all the APL experience comes in, where if you worked with a laboratory, you communicated with a laboratory, you weren't at odds with a laboratory, they would develop an ownership that stood you in very good stead. Again, the Program Manager had to know enough, and some of the younger ones didn't, so we had to get them educated, to be able to do that because there's always a tendency amongst industrial program management, 'Hell, I could do this by myself. I don't need those guys at APL or China Lake or anybody else helping me.' Well, that's nonsense in today's very complex world.

"The corporate level. If you had corporate assets, and I've already indicated we were unique in my estimation of having had that. Maybe Lockheed comes pretty close to that in having a similar thing at the senior level.

"At the corporate level, I could always go to Dave Lewis for help if I had a problem. Sometimes if I didn't get there first, he'd have a piece of my you-know-what because I came so late to get help. We made extensive use of Red Teams across the total corporation. If we had a technical problem that we were really gnawing on, we could get a technical team put together from across the corporation to come in and work with us and bail out the engineering group or the program group at that time.

"We could do that within contracts. We could do that within program management. Almost any phase that we might get in trouble on, we could get a corporate team to come in and work with us. Because at that time, during that period, the recognition within the corporate structure was that program success equals a better program equals a better return for the Division. Without the program's success, the rest of it did not occur. And David Lewis used to hate getting a call from some Admiral or some General that said that one of my programs or I as General Manager of was on its butt. And, believe me, I didn't like David on mine. So we had a very good system within General Dynamics where we could go for help when we needed it.

"What institutions helped or hindered the most? Now, here I'm not going to talk from a Program Manager point of view, I'll talk from a General Manager point of view, and very often there is a certain level of parochialness even in the best of the Program Managers. And a lot of this, of course, is institutional leadership and individual player-dependent and to a certain extent very specific program related. So you have to be very careful with what I'll say in that regard. And what seems to have impacted the circumstances of hindering or helping the most was, what was the attitude of the service Program Manager? Did the service Program Manager think the laboratories were important? They needed to be involved.

"How clear were the roles defined by that PM? What was APL's role? Or what was the Fleet's role? Or what was NSWSES' or whatever relative to that program and your product or your part of the product at that time?

"The communications link between Pomona and those institutions. Some of us worked hard on keeping those communications links open, and some didn't. The priority of the program by both the service and the company had a lot to do with the circumstances. The relative success, or failures, that the program was enjoying at that particular time was a very important set of circumstances. And the communications and attitude at the working level, the engineering working level, were very important. It set the circumstances of who was the good guy and who was the bad guy relative to help and hindrance.

"But in general terms, the helpful ones were APL, Navy contracts, ranges, Congressional members, SECNAV with one exception and that was John Lehman, as I've already mentioned DDR&E, and the user community. Those were considered helpers.

"On the hindering side, DCAA, some of the congressional staffers, and a long history of ASN's as being one big pain, quite frankly. And of all of the agencies the only one that was a hindrance was China Lake, and that was because there was inherent conflict over who invented what. The feeling at Pomona was you could never trust them. I can remember some examples of when we were fighting miss-distance problems. And we had solved it in STINGER, and China Lake hadn't solved it. And Bill Porter came trundling down with his group, and sat across the table from my engineers to find out what we were doing in order to get the accuracy we were getting. And we're talking about certain algorithms and whatnot. And Bill Potter asked Terry Tenet how they did that. Terry, who was five foot five, blue eyes, smart as hell, looked right across the table and said, 'I ain't gonna tell ya.'

"Now, in later years on RAM we were able to get that turned around, but in the early years that was the only one that we had any difficulty in working with.

"Let me wrap up and say that GD/Pomona was a unique organization, nurtured by the Navy with a very clearly defined role, and it was blessed with excellent leadership. And that's why it was successful."

DR. COLVARD: "Next we have another distinguished alumnus of the Navy laboratory community, Dr. Walter LaBerge. He was the Technical Director at China Lake, and later held a number of senior positions in the defense establishment, including Assistant Secretary of the Air Force for R&D, Assistant Secretary General of NATO, and Under Secretary of the Army. Dr. LaBerge."

DR. LaBERGE: "I want to talk about China Lake in the context of it being a part of an evolution, which I think is common to what we'll hear from people like Wayne and would hear from the SP people if they were here. That there are some common trends in how things evolved, which had some very good points and which, perhaps, grew, as Ralph says, into some arrogance and some not good points.

"I thought I would start, though, by reading to you the theme song at China Lake. It will give you a feel for the place.

By the old Sierra mountains
looking eastward in a lee
lies a laboratory building
that's off-limits by decree.

And the rain that's in the desert
for which my heart does yearn,
come ye back ye civil servants,
come ye back to Inyokern.

On the road to Inyokern
where my many friends sojourned,
can't you hear the sands ablowing
from Ridgecrest to Inyokern?

On the road to Inyokern
where the missiles twist and turn
and the dawn comes up like thunder
from the mountain 'cross the way.

When the bloom is on the desert
and the skies are blue outside,
'tis the time for shooting missiles,
which with targets do collide.

And the glory of their crashing
and the splendor of their burn
is a sight you'll never see
'til you've come to Inyokern!

"The place really had a spirit born of succeeding and born of thinking that they were reasonably good. And what I wanted to talk about was how it got that way. Wayne reproduced it in a different way in his organization; Rayborn did it differently in his organization. But the very good organizations had very good people at the top and essentially inculcated the key criteria of good management through people who were primarily of technical origin and of technical business. And that transitioned, as Ralph said and others, as things got old and the business got more codified. In many respects, I believe we misunderstand why acquisition improvement has been necessary. I believe that it's not fixing a broken system. We broke the system that worked and then had to fix it with acquisition reform.

"So let me go back to talk about China Lake in the early days as not all that different from several other successful organizations that the Navy had in those days. The origin of the place was out of work done at Cal Tech during the war, where Cal Tech had responsibilities for developing ordnance for aircraft; they needed a test facility, came out and discovered an airfield that had been built by the FAA and not used in the middle of the desert, kicked everybody that was there out and essentially established that.

"What they brought were some absolutely first-class people and the standards of Cal Tech. Now, Cal Tech and universities got their standards not because God made them more honest than other people, but because there is this sort of a peer-review process in the universities that are any good that essentially requires you to run your work past other people and to be open and honest about it. And people were not open and honest voluntarily. It's a system that one set up that caused this emphasis on competence, emphasis on publishing exactly what you did, the emphasis on being willing to expose what you were doing.

"But I think the predominant thing that came with it was the taste that Charley Lauritsen and the Cal Tech people brought to China Lake in 1947. And the first technical director was Dr. Thompson from the staff at Cal Tech. And that lasted some number of years principally because the torch of leadership was for many, many years that of Bill McLean, whom I had the marvelous opportunity to work under.

"I worked in the SIDEWINDER program, but if you look at the China Lake glory days, they have clearly defined beginnings and ends. It started in 1943, ended in 1974, and a whole different China Lake exists now. The pressures that made the earthquake happen, happened long before the earthquake came about. The earthquake was magnificent when the CNM, Ike Kidd, sent Doc Freeman out to get the place 'under control'. There was a clearly defined shift in roles from being the provisioner to the Navy of its air armament to being a helper to the Systems Commands in the provisioning of armament to the Navy.

"Look at the products there, the 3.75-inch rockets and the five-inch rockets and the SHRIKEs and the ARMs and the SIDEWINDERs and a whole pile of stuff, all of which could have been done someplace else but were done at China Lake. The reason I believe it's important to sort of go through this harangue is that I don't believe evolution can be changed until something momentous happens. But that momentous thing which caused our current system to grow, I believe, is going to be substantially challenged by the budget process that we're now going to see.

"And if you're going to do missile defense and everything else, I believe you'll find you are no longer able to support a broad-based industry, with Program Managers responsible for the work. And you may have to revert to arsenals of some sort where you concentrate your resources and you make industry alliances that are essentially noncompetitive in the way that Wayne did with you guys and we did with Philco and people like that.

"At any rate, the early days were really creative. And it was all Bill McLean. And Bill McLean was there because of Lauritsen and the standards that Cal Tech set. And without Bill McLean, the place wouldn't have been nearly as good as it was.

"The problem SIDEWINDER had was that you had seven vacuum tubes that would work under the acceleration and vibration environments of the day. They all came out of the influence fuses. McLean had worked on that sort of thing, so he knew what the technology was that was available to him. And we had a bunch of rocket parts and warheads in the various lockers around the station. The question was: How can you provide a guided missile system that really helps the fighter airplane do combat when you switch from propeller engines to jet engines using gas rapidly that you couldn't close on other jet engine fighters very easily and were restricted to one pass. You needed some way to stand off.

"The Navy had SPARROW, started a couple of years earlier. It had selected radar as its principal mechanism for guidance. The scintillations that are inherent in comer reflectors and radar systems limited the accuracy, so correctly the SPARROW system ended up with fifty-pound warheads because you expected to have misses. And if you're going to push fifty-pound rockets fast enough to catch fast jet airplanes, you've got to have a big rocket motor and you sort of scale up directly. And the question that Bill chose to address was: How can we do this and put it on things like the F-86s and reasonably small airplanes where you provide a number of shots, rather than just one?

"So you had this bunch of vacuum tubes and a clean piece of paper. And I think the major message of my growing-up period was that it was what the technology would let you do to define the requirements, rather than the other way around. And the projects that had control of the technology and the testing were able to do that. The projects that didn't have control of the testing process and control of the money were locked into contracts, which required a completely different way of approaching the problem.

"Well, Bill ended up saying, 'I don't know much about aerodynamics, and besides, they won't give me a wind tunnel.' And so we essentially started off knowing that you were going to have to build an airplane independent of aerodynamics. So you go to the logical one, which is a feathered arrow where you have lots of stability in the back and with canards up in the front. And where the CP and CG shift to at various speeds, attitude, and degree of burnout don't make much difference because the moment arms are large, and small sliding back and forth of and things doesn't make all that much difference.

"When you buy into a canard airframe, you buy into the fact that when you wiggle the front wings; the downwash runs over the back wings. And about the time you say, 'Go here', you actually go this way, and so you had to solve that problem. But Bill was willing to look for a way through that set in order to be able to get the advantages that came from not having to compute angles of attack.

"There were two ways; I suggested the losing way, Bill suggested the winning way. And I actually brought it in. But it demonstrates both ingenuity and the fact that you have to have God on your side. If the right hand ruled where the left

ruled, you'd be in real trouble. But as it turns out, you use the air to spin the wheel and the tab. When the missile tends to roll, you put a torque on what is now a gyroscope. And if the tab is free, it deflects out into the wind in a way to reduce the roll rate by a factor of ten. And that's all, it turns out, that you need to do. So Bill said, 'We'll do it that way', and it actually worked.

"Then the next question was how in the world do you take an airframe that wiggles back and forth all the time and compute where the velocity vector is, where the missile is pointing, where you want to go and all that. So we basically said we don't want to do that. Why don't I provide, essentially, a gyroscope in space that we will stabilize by a spinning magnet and not coupled to the airframe so now I can wiggle the airframe any way and it doesn't affect the gyro. And that way I don't have to compute all of this stuff.

"And it turns out that's the design that went in the original one, and basically the one that is still there. It fights its way out of having to deal with the things that you couldn't deal with; however, because we had a canard air frame, you basically had to have a lot of torque on the front fins because you had these aerodynamic, big feathers in the back.

"And so we essentially said, 'Let's go produce torque directly. I don't want to have to set wing positions hither and yon. I'll just produce torque independent, again, of how the airframe is wiggling.' So we essentially developed the gas servosystem that took the rate at which the seeker was turning, and povided pressure in the gas system so that it provided torque as its output, independent of the wings.

"And Bill was just absolutely marvelous at training people to understand what your limitations were, what the technology could let you do at the time. And he was closely enough coupled to the management in Washington to be permitted the time to make sure that he knew how to make the parts work before he had to make the system work. And so one of the real characteristics of that time was that the Navy in Washington was tolerant of China Lake and had a great trust in it. And they got that way, not because the people were inspired, but because they had all been sent through China Lake. Navy management at that time were aviators, and Tom Moorer and Hayward and all the rest of the people who came through China Lake, got to trust it, and provided cover against all the people who wanted to stop the program.

"So I think one of the early lessons was you have to have very good people. But you also have to have cover in some form so that you are allowed to deal with problems, rather than having to essentially take high risks because you don't believe you can get any tolerance to schedule slippage.

"So at any rate it was, I think, a system that started off with the station having an engineering management that solicited inputs from industry very early, but which

kept the control of the design until very late in the process. And I believe that's fundamentally important to why things worked well before, why they don't work so well now, why we need acquisition reform. Because we essentially make decisions far too early on what we're going to build and bind ourselves up in contracts that don't let you out of them.

"However, while Bill was there he was clearly recognized as being very, very good, and the Navy supported him. When Bill went to run the underwater labs, that whole process began to erode. A fundamental issue, though, that had been locked in very early was the formal charter that was signed saying what the rules of the military and the civilians were in the process.

"At China Lake there was parity between the two. You had a commander and a technical director that were co-equal, but the commander knew his job was to support the technical operation, and the technical people knew their job was to keep their commander on the promotion list by essentially making the promise that he as the commander makes to upper management fulfilled. And it was an actual written charter, and I tumed out to be the last Technical Director that lived under that charter. And when Doc Freeman came out, he essentially changed the organization, and subsequently it was changed more.

"And I'm not arguing it's good or bad. I'm just saying that it was the way we grew up. Now, I don't think when you get so many, many programs as the defense budget has, [you can]operate the way China Lake operated in the old days. You can only do this a little bit before you run out of this unique capability. But at any rate, there were some things that made the place good, that I would rank first, the standards of Cal Tech; secondly, promoting the very good people you had. Howie Wilcox was just very, very good people. The system didn't run to administrators, it ran to technical people. We can train technical people to be administrators more easily than we can train administrators to be technical. But that was sort of reinforced by letting the technical business be in charge of trained technicians.

"As you shifted this thing, a number of things happened. I thought I would just sort of walk you through my view of what happened to China Lake. First, the war went away. And it was very clear that when you have wars, you have got to shorten time cycles and make systems that get things done, even though they may not be fair and have adequate competition.

"China Lake grew up during Korea and Vietnam, that was the dominant pressure, and it got away with things that it couldn't get away with as peacetime came about. As peacetime came about, the Congress shifted its interest predominantly from supporting war to making sure that it wasn't fought. And so there was tremendous emphasis on procurement supervision in the Congress which led, in my view, to Washington having to pull the Program Managers back from the field, from the Dahlgren's and the China Lake's and the like, back to

Washington so there could be a rapid response to the tremendous budget pressures that came from people wondering whether you should continue or cut programs.

"So, first, the war went away; secondly, the Program Managers moved out. Jack Chrisman, for example, was there for two tours as the Bureau's representative on base, and we had, really, a marvelous linkage between the Navy management, the technical people, the VX-5 squadron, and clear access to the Navy. We had it all in one place.

"The whole thing began to break up. It continued to break up as people separated, suspicion started, suspicions grew into distrust, distrust grew into overt annoyance, and what it led to was Doc Freeman coming out to put the place under control. And he wasn't very good at it in the sense that, you know, the band used to march down at six o'clock in the moming in front of Admiral Freeman's house to rehearse in order to wake everybody up. There was practically open revolt.

"And the Navy sort of let it happen in the sense of seeing a bummer take place where both sides behaved poorly. But the net result was that the Systems Commands became very comfortable in going directly to their contractors, and the China Lake role basically disappeared.

"I don't think it could have been constrained in China Lake as things grew, and so some set of evolutions had to happen. I think a more sensible one would have been much as Wayne set up, a broad-based project-oriented organization. What China Lake does now is very useful, but it no longer invents anything. I was trying to write down what China Lake invented since 1974, and it's really M through Z, or whatever in the AIM-9L series, and there they're only because the follow-on to SIDEWINDER never materialized.

"Now, is the Navy ahead or behind by the demise? I basically argue it's behind in a way that it doesn't recognize. Sitting here suggesting that the Navy was anything other than perfect in the face of an air three-star and a surface three-star is dangerous. But because China Lake was the goad to the Navy to be dominant in air warfare, and because it pulled it off, it was the dominant supplier of offensive air ordnance, a job which was ceded to the Air Force as the pressure grew to believe that the Navy's principal job was to crush the Evil Empire by massive sea attack on the Kola Peninsula or the like. Surface ordnance became a much more dominant issue, and the Navy ceded that. And I believe you saw the consequences when the Gulf War came along, and, it is still true today: Navy air is not the dominant technological driver. We came late to having laser-guided bombs in part because somebody else developed it, and there wasn't the in-house goad to make that happen.

"So an unrecognized, in my mind, difficulty with China Lake going out of the weapons provisioning business into a weapons support business was that there wasn't the goad that could have kept them the dominant instrument. And now, since the Evil Empire went away without us having to go to the Kola Peninsula, we find again that supporting Marines ashore turns out to be a very important issue. And we don't have that instrument, in my mind, to fulfill that mission.

"So the lessons that I bring to this is that it's all an evolution, where the times had a lot to do with how it turned out and broke, and that we'd better learn how to make the current system work, as long as we have the business phase that we currently have. But if my guess is right, the business phase is going to go down very substantially. Then we had better find some way to be able to do R&D and early developments and get the new things that can happen or better assured on the airplanes."

DR. COLVARD: " We'll get another view now from Vice Admiral Paul McCarthy, who not only commanded the Seventh Fleet, but had three senior tours in OpNav as well. His OpNav experience that is most relevant to our discussions today was as Director of Research, Development, Test, and Evaluation, Op-098. So his responsibilities there cut across all Navy warfare areas and platforms. Admiral McCarthy."

VADM McCARTHY: "Let me pick up on a subject that is an Op-098 subject, really. Phil asked, how do you develop requirements and how do you fund the requirements, and deal with the communities that are out there, making sure you are putting out the requirements from the fleet aspect. And that you're getting industry onboard in order to answer those requirements that the fleet wants.

"Take a look at it from where we are today. And my perspective, having been out in industry and involved in some of the programs, you can take a look at DD-21 and the Joint Strike Fighter, the programs that are out there today. What you find is that the Navy sets out very specific requirements on what they want, but they do it in a rather general sense. And by that I mean they will tell you specifically what they would like to hit as far as a signature issue, as far as a range, and they'll package it all up and they'll present it to industry. And industry will take a look at that and they'll say, 'My God. I'm not sure that we can really do this for the dollars that they're talking about.' And, of course, the issue is: How do you balance the two?

"The Navy has lost a good bit of the technical expertise that would allow them to say this is a reasonable approach. You know, the dollars that we have here are available to satisfy the technical requirements that we've set forth. Ralph was talking about what happened at General Dynamics with John Lehman and second-sourcing. And you can see that there has been a great deal more focus, obviously, because of Congressional aspects on programs: how the Navy is doing, how the budget is doing, where the cost is, whether it is a cost overrun

condition, whether you're on schedule or not, and how well the Program Managers are doing. And the Navy has responded to that, and they have tightened controls on cost. And they're very much into what is the cost of a program.

"If you look out there today, there are hoards, legions of people that are looking at cost. I mean, we've got people down on the factory floor that are trying to determine what those costs are. How does that equate to the requirement? Well, go back to how we used to do it, okay? To the late fifties and early sixties.

"Walt was talking about China Lake. And I'm also a victim of my own background. I spent some time at China Lake. And the issue at the time out there was, how do you maintain combat experience and people who could develop the requirements and the weapons for the future? How did you maintain that between wars? Because that's always kind of a sensitive area. How do you maintain it between, for instance, Korea, Vietnam, Desert Storm, Kosovo? It's really hard. And the thing that you always watch out for is that you are always, whether you like it or not, influenced by the last war that you fought. And it's really tough to knock that out.

"In the late fifties and early sixties at China Lake, you had a very, very strong and dedicated technical community working in a reasonably austere environment. You had a number of technicians to support that technical community and you had a very hard-core, I would say, group of operators that came up there. That wouldn't have been so important if one of the things didn't happen in that, that whole crucible, in that there was a great interaction between those groups. It was not uncommon to see pilots down in the laboratory talking to designers, to see technicians and pilots working on racks and rails at all hours of the day or night. And the evidence or success of that kind of an arrangement when you looked at the products that came out, and remember those are the products that we went into Vietnam with, SIDEWINDER that Walt worked on with Bill McLean, and SPARROW. And these things have lasted generations.

"You know, you go into three generations, or three decades, with those kinds of weapons. You're looking at the very beginning of the air-to-surface weaponry. Things like BULLPUP that were out there then. And then the BULLPUP-B. You're looking at WALLEYE and WALLEYE-D. Gosh, there was just a whole host of weapons that came out of it. SNAKEYE was one of those. But all those were the results of people working together, both in the technical and the laboratory community, with good strong emphasis from the operators.

"Things tend to fall through the crack between wars. And as I was listening to Alan I was thinking of where we are today with ASW and the diesel submarine that is kind of drifting off into the ether. And the thing that always drifts off into the ether between wars is mine hunting and mine laying. Those are sort of traditional areas that just go by the board.

"The interesting thing back there in those days is that there wasn't a significant price for failure. You weren't nailed to the cross if you failed. People recognized that that was part of the process of developing good systems. You learned. I mean, you didn't lose anything. You learned something. So, weapons like INKEYE and WETEYE and BUGEYE as compared to SNAKEYE, they went to the other side of the ledger. But GAO didn't get on you. You didn't get a call from Washington. Ace Lyons wasn't at your front door the next day, and those kinds of things. So, I mean, failure was part of the package. Today that's not so true, in part because of the price of weapon systems that you have, but there is a stigma that goes with that sort of thing. It's true out in industry, also, but not to the same degree it is today out there in the community.

"Phil talked about five to ten percent of the people really drive the organization. That is true in any arrangement, whether you're setting requirements, whether you're developing a Program Manager, or whatever. And in those days we had a share of the five to ten percent of the right kind of people out there in the desert working some of these programs. And it's necessary to do that.

"If you don't have that kind of a person out there, you will not develop the success rate that you truly want. You can finesse it a bit, and we did so with McDonnell-Douglas and Boeing through the use of processes and tools. And you can expand that five to ten percent maybe out to twenty percent, but you got to have the baseline core to develop that kind of a strategy in order to be able to do that sort of thing.

"Phil talked about study groups. You don't see those anymore. We used to have study groups that, good golly, they went on for about eighteen months and people would be locked up in the old BuPers or down there in the basement of the building. But those study groups, in conjunction with what was going on out there at China Lake and in some cases Eglin, even though we don't like to admit it, and over there in Point Mugu where the people are truly developed and understood what the requirements really were.

"And when those requirements went out to industry, they had a very good idea of whether it was doable or not. Not that if you wanted to achieve some signature level that was nearly impossible to do. If you cracked one door in a ship, it destroyed the entire signature. But that's not understood today. We did have flexibility in the industry community with IRAD, which is important and which industry really needs. Hugh Montgomery was clever enough in my tour there at OP-098 to bring on the 6.3A type of structure that with a little bit of money, about ten to fifteen million dollars a year, we could select a few ideas that we could go out and experiment with. But where you are today, it's tough to kind of do that sort of thing.

"I think with that, I'll wind it up. Admiral Doyle talked about areas that you could help in and areas that were very helpful. If you had three stars and you were working R&D jobs, it was easy to make your point known, whether it was with the industry folks or whether it was with the Secretariat or whether it was with the CNO. If you look at the structure that exists back there today, as far as what OpNav has and how it has to deal with the Secretariat and what the secretariat controls, once you get a program under way, whether the requirements are right or wrong, that program is going to go ahead. It's pretty hard to change those particular requirements once you get the thing structured. I'm not sure that's quite a good thing. I think in the revolution of how we do business in the future is something that's probably worth a look. That's all I have."

DR. COLVARD: "We have talked about understanding the laws of physics. We have talked about understanding the permissiveness of technology and the readiness of engineering. We have talked about the problems of getting funds. Now we turn to Rear Admiral Wayne Meyer, whose wide-ranging background includes operational duty both at sea and ashore, as well as engineering responsibilities in the Navy's field activities. But his major contribution to our Navy's capabilities was as the founding AEGIS shipbuilding manager. He is the only person in the history of the Navy who has taken a complete combat system including the weapons and the ship from conception and development through to production and introduction into the fleet. He is rightly known as the "Father of AEGIS." He was also the Deputy Commander of NavSea for Weapons and Combat Systems. Admiral Meyer."

RADM MEYER: "Well, thank you, Chairman. There was a TV program that lasted a very long time called'The Naked City.' It was centered in San Francisco, and it always opened with the statement: 'There are a million stories in the City.'

"You cannot have been associated with such a movement as I have and not have a million stories. So the difficulty is which stories to pick. And as I look around the table here, there's not a single one of you who have not had a significant effect on my life or my behavior. And even at least half of the side benchers here have significantly affected my behavior, or the outcome. So I would like to for my time to try to step back to how I think it came about.

"I enlisted in the Navy on the 12th day of May in 1943. Only a year and a half or so later the nation was horrified because the Germans had attacked with what was popularly referred to as a "buzz bomb," the V-1 rocket with a pulse-jet engine in it. And subsequently with the V-2 rocket attacking all of England and London and such with the threat that Peenemunde was working on the A-4 rocket which would be used to assault New York City and other big cities in the east.

"But then in October 1945 at the Battle of Leyte Gulf was one of those defining events, which you all have alluded to earlier this morning, and that was when

something occurred that the Occidental world simply couldn't deal with. And it was a divine wind, or it came to be called a Kamikaze. The Occidental just could not adjust his thinking to believe that were men who would strap themselves to a bomb and, in the name of their emperor, literally commit suicide by diving into a ship.

"And we knew not how to deal with that. We just didn't know how to deal with it, except to bring every weapon to bear that we knew. We emerged from those years finally to Okinawa in April 1945, the longest and the most decimating battle that ever occurred in Naval history. More officers, more men, more ships, more airplanes lost than ever. And it left an indelible mark on our Navy.

"Well, what happened in the case of these weapons, these three, the two I mentioned in Germany and the Kamikaze. We somehow could understand the German ones because there was no man strapped to it. But we couldn't grasp what was happening in the Pacific. I get very upset when I find people rewriting history, particularly concerning the use of the atomic bomb. I think that President Truman made an extraordinary decision of the need to do so. So what really happened is, the war ended. We never overcame them. The war ended. That's how we solved that problem.

"So when I look at my life as it flowed from being commissioned in the reserve Navy, transferring to the regular Navy and sailing around the world and in sundry ships in those years, part of the occupation forces, part of several wars which had occurred throughout that era, my whole life has really, really been driven. Not by my choice, particularly, but it's almost as though God had a destiny for me, when I thought about it in later years, by the cruise missile or the Kamikaze. So you can define almost everything that I have integrated up or led or done as being driven by that compulsion, which all of you here at this table had a role in, in one dimension or another, some in much longer periods than others. That's what drove my life.

"And I listen to this extraordinary recitation by Jim Doyle, a short summation, one of which I've never heard him say it as well before. There was that really short era, half a decade or so, that did change the world. And it did change the Navy. And it changed it irreversibly, and each of you has alluded to it when your turn came.

"I don't view myself as a scientist, by any means. As a matter of fact, I like to think I'm an engineer, but that's really pushing. I've never, ever literally gone into industry and worked on a bench. Much of my education came from right here at the Postgraduate School. And it was a very fortuitous education. I would not be what I was without it. And the incredible professors and officers who guided me and caused me to study, in particular, fire control. That era contained sponsors in the Bureaus for this school. In my own case, it happened to be Commander Mark Woods and Commander Bob Vickrey in OpNav. And I remarked last night

to the Provost that when I was in this school, every single month those two officers appeared at this school. Every single month!

"The officer in charge of the ordnance curriculum was a senior unrestricted line Captain. In our case, Captain Bob Hodeni, who had come from commanding a destroyer squadron. He was the O-in-C. Glassko was the Dean. And every month they quizzed Hodeni on how he was doing with these students. They literally went into the classrooms and listened to lectures on thermodynamics and on servo-mechanisms, which, of course, would be sometimes upsetting to the professors. And then they would get hold of the students. They would hold interviews with them, group interviews, single interviews and such, because they viewed that as extraordinarily important to the Navy. And the Bureau Chiefs were those sponsors, and they're the ones that kept that focused in that era. And I am a product of that era.

"I really think of myself as a Naval officer. And I would like to think a pretty good one. I sailed, oh, for on the order of twenty years, in numerous places of the world, and in numerous roles. And to me what is most important in being a Naval officer, besides the patriotic aspect and determination, is the discipline of leadership, having to deal with incredible mixtures of people, constant disruption, constant turnover, and precision. You said it so elegantly earlier here, Walt, that in commanding even a little old stinking minesweeper, you'd better be awfully precise in your behavior. And Paul mentioned the price of failure. The price of failure is very high.

"So that discipline, while not absolutely unique to the military, is more dominating to the military than nominally you see in a civil structure. In that connection, Phil sent me, several months ago, a copy of the book 'SIDEWINDER'. First of all, it's really interesting reading and good reading. But as you study this fellow, McLean, you start to realize that we are approaching soon a half a century where the centerpiece of much of the fighter forces on the globe came and flowed from that SIDEWINDER. It was alluded to a couple times earlier. Think of that. A fifty-year odyssey that flowed out of that summation of invention.

"Several of these officers here summed up the significance of that participation by operators and development of officers to go on to be leaders. Why do I mention that? Because I don't believe that I would have ever ended up in the destiny that I was in without that kind of thing. It would never have occurred."

DR. LaBERGE: "I take it you say it wouldn't occur today?"

RADM MEYER: "To my knowledge, first of all, the AEGIS project has never been duplicated. On the contrary, there's many efforts to deny it, it has never been emulated, except in some way that suits the purpose of somebody else. It is a project which today, over thirty years later, has never been out of budget and never been in overrun. There are fifty-eight major warships at sea. There's

someone here amongst us, he is sitting here behind me, his name is Parker [Dr. Patrick Parker]who is fond of saying that it is the largest program in history, as far as expense and undertaking, although the United States Air Force is certainly putting it to shame.

"But I'm appalled when I look at the record today; I don't know a single shipbuilding program that's under its budget or within schedule. I am absolutely appalled as I look at them and the leadership that has been assigned, or the administrators, I suppose you say, to take care of these.

"Tenure is a requirement, as was mentioned, but it is not sufficient. Like the old expression, 'necessary but not sufficient.' But tenure sure helps. Now, if you get the wrong 'ten-ee', then you've got a problem. So then you find that you got to out-tenure the tenure, so to speak.

"Well, I thought of a few cases of how important relationships are in the million stories in 'The Naked City', and one that come to mind was the moving target indicator case. First of all, let's talk about the signal processor for a moment. The signal processor was born out of the TYPHON program. And the signal processor would occupy most of this deck, most of the mezzanine in its size. And when Eli [Reich] convinced the Congress to shut TYPHON down and to take the seventy-six million dollars, which was in the budget that Rickover had for a long lead for the first of the TYPHON cruisers, which would all be nuclear-propelled. TYPHON was returned to experiment, and Eli got the seventy-six million dollars to operate the so-called 3-T get-well program, and Rickover never forgave him until he went to the graveyard for stealing the seventy-six million dollars, which was really meant to sustain nuclear engineering along the way.

"What was one of the lessons out of that? The Navy tasked the Applied Physics Laboratory to develop TYPHON as not only the technical direction agent but even the Program Manager. And the Navy held a competition and selected Westinghouse Corporation to develop the radar system. You will recall it was to be a fixed array. And it was to be powered by some four thousand traveling-wave tubes and this massive signal processor. And the rationale was, well, in the test ship, we'll move it close to the scene of the crime. And so NORTON SOUND was brought to Baltimore, cut up, and given the joint custody between APL and Westinghouse.

"There's an important lesson there, in my mind, and that is that you cannot put a big engineering project under a laboratory because it argues against the very nature of the laboratory. Its very nature is to experiment and do research and such. And I learned the hard way that we had industry to do engineering. We have laboratories do experiments and research. Well, now, fast-forward to the first AEGIS, which had some 22 cabinets in a signal processor. And had moving target indication, MTI, as a requirement in it. And there was continuing

argument, fussing, fighting, almost on a national basis on how many coefficients of the equation could you get into that design.

"And, of course, RCA, one of the greatest outfits ever raised, even exceeding Sperry, perhaps, in its grand design, was on a schedule and being measured. The Applied Physics Laboratory kept fussing around, interfering. Other laboratories were fussing round, interfering, saying, 'Well, that ain't the right design. That ain't the right design. Let's do this. Let's do this.'

"I said, enough of this. We're going to freeze MTI as the RCA design is, knowing that it is not adequate. And we're going to retum MTI to the laboratory and send it back to APL and set up a joint structure and everything to, in fact, go do the necessary research and the necessary experimentation to overcome the flaws that existed in the MTI.

"I recall we sent NORTON SOUND on a long cruise up into the Bay of Alaska; its sole assignment was to gather data. And she gathered some six million data points on the MTI design, and proofed it. And ultimately it entered into the production AEGIS system.

"Well, the single processor went from room-sized down to twenty-two cabinets and then to eleven, when it came out of NORTON SOUND, then in the engineering development model up at CSEDS to eight cabinets. Then the next maturity was four cabinets. I believe today it's two cabinets. Of course, these two cabinets today, no one would dare try to carry them because they ain't carriable. They're really packed to a fare-thee-well. But it taught how important, not only tenure, but evolution is. Alan mentioned earlier, that occasionally something momentous disrupts evolution and how important that is.

"He mentioned the overhead surveillance and the conflicts. Okay. I've been on the Ballistic Missile Defense Office's National Advisory Council for seven years now. And for that solid seven years there's something called "SBIRS." SBIRS high and SBIRS low. Spaced Based Infrared System. It is no farther along today than it was seven years ago because the structure is so flawed that it cannot make a decision between overhead surveillance, between the requirements of intelligence and the military and the demands of the MDO. It cannot resolve those things.

"I want to say something about the Advanced Surface Missile System. It's one of the obstacles in the way. Recall for a minute the momentous event of 1967. The Egyptian sinking of the Israeli destroyer was one of those momentous events. And in December of 1969 under the AEGIS so to speak, of DCP-16, which was described as the Advanced Surface Missile System, twenty pages along under Johnny Foster. And it is, by the way, the governing document today, thirty years later, still the governing document for AEGIS design.

"But at the last minute it was determined that the ASMS missile was too expensive. One of the difficulties was the McNamara's geniuses and the newly created heroes which continue to be sustained, called 'Systems Analysis' had determined that the Navy had no need for a surface-to-air missile more than fifty miles in range. That was the most the Navy needed.

"So the missile was determined to be too expensive. And two weeks before Christmas it was determined to strike the missile out of the development. Captain Lou J. Stecker happened to be the aide to John Foster when they were sitting late at night arguing on this. And Lou Stecker picked up his pencil and wrote a phrase in there, which said: 'The missile shall be Standard Missile with midcourse guidance.' Just a phrase. That is what was written in. Closed the deal. Christmas week the contract was let to RCA Corporation. Not one nickel was laid out for the missile. There was no program any place for the missile, and no one had the foggiest idea what 'Standard Missile with midcourse guidance' meant.

"But it was one of those little teensy things that changed the whole course of history. And the irony of this thing was that the contract was awarded to RCA because the Navy felt so strongly about trying to get a fixed array radar, and viewed RCA as the strongest. And they were teamed with Raytheon and, therefore, it was overwhelming. Bendix was on that team. And with the missile being struck, Bendix disappeared. General Dynamics/Pomona, was on the losing team. And there was sadness all during Christmas in Pomona because the mighty Casey had struck out. And yet look how it was reborn, totally reborn, in another whole manner.

"That one little phrase and one leader. I learned a couple things through those years that I believe have enduring significance. One is, you have to work with what you've got, until, as you said, some momentous thing occurs. You've got to work with what you've got, not with what you want to wish would be. My personal view is that this is a fundamental flaw right now in the DD-21 effort. You have to work with what you've got.

"Number two, tactical dimensions are significant and important. And all of you at this table in your lifetime have been through crises that occurred with tactical dimensions, particularly in air-to-air weapons. And recall the infamous Liz Begg's investigation where she was sent to look into the panoply of weapons we had of various dimensions and how to fit them in our airplanes.

"So what drove AEGIS to where it is, is Standard Missile's thirteen-and-a-half inches. And if you couldn't get it in that thirteen-and-a-half inches, you were to go weren't going to get it. So necessity drove the engineering. It's what kept the PHOENIX missile out and later in life the PATRIOT missile, because their dimensions didn't meet the tactical structures, logistically, that we had to work in. And I think that that is an important lesson.

"I mentioned tenure and work with what you got. Rickover taught me, really, a couple of significant things in my life. One is very well known, and that is: the devil is in the details. That was one of his favorite expressions, meaning that engineering is detail, detail, detail, detail, detail, not generalities.

"But he had another one that you don't very often see. He said, 'You must make all decisions as though you're going to live forever.' That is to say, you have to be prepared to live with the decision, meaning you can't make expedient decisions no matter what the cost. You must try to make the right one. Well, it doesn't follow that you do, but the matter of the code, to me, seems very significant in trying to deal in large programs.

"I want to make up another story in 'The Naked City'. It had to do with a point that Jim Doyle made. When we started out in this design, there were no screens at all in the design. Even though there were specialized consoles, Bill Goodwin and I drove them out of the system, to get to the Navy standards, UYA-4, which sailors all knew how to use already, which was very significant in my mind. And since it was, in essence, a destroyer design, it had no flagship requirements.

"Well, of course that evolved in a few months: we need a unit commander's requirements, so we need a screen. And by the way, we want independent facilities for the unit commander. So we want him in a room that's totally isolated from the CIC so he does not contaminate the system. You can understand that. Build a glass. He can look through the glass, and whatever he got, he could act as unit commander. Well, of course, that didn't last very long.

"I want to talk about tenure and the significance of interchange because Admiral Doyle wasn't the first OP-03 that I dealt with by any means, as you full well appreciate. I had some really free spirits there; for example, Frank Price, Roho Adamson, just to name a couple.

"Jim Doyle again, one of those momentous things, or defining moments as ComThirdFleet, laid down in TACNOTES the Warfare-Commander concept, which has prevailed to this day until the reformers are starting to disassemble it, and that formed the basis for CIC design. And then we had to do something about Flag design. And so he wanted screens. Well, here was a risk situation because there, in fact, were no projectors available that could provide those screens with high reliability.

"And that's when we embarked on the liquid-crystal projector with a scientist out at Hughes-Fullerton. And it turned out to be a high risk, and in some respects even today is a little iffy sometimes in its operation. But that liquid crystal is what pioneered these screens into our ships, even though there are any number of people on the benches who would say, 'That's not modern.' 'You're not keeping up.' 'We've got all this touchscreen stuff coming along.' But none of it met the

rigor needed in shipboard application in reliability and maintenance and so forth. I thought that was a very significant, important thing that occurred. So where four screens finally emerged, and these, in fact, became significant flagships within our Navy, because of the four large-screen displays.

"In this program, there was an obstacle that hardly anyone thinks of anymore, and it was Vietnam. In the anti-Vietnam attitude, which emerged in our nation, RCA virtually tried to deny that AEGIS existed. In fact, the RCA Corporation printed two annual reports in a row that failed to mention AEGIS in any way, shape or form. And what finally blew my head off was when Bill Goodwin, my friend, associate, and also the AEGIS manager, had to make a periodic report to 30 Rockefeller Center one day. And he got over there and they told him, 'Look. One Elvis Presley record brings more income to this company than you're bringing. And that's where you stand.' And I've never forgotten that little incident, that there at 30 Rock we were in the category of an Elvis Presley record.

"Well, it kept getting a little worse. So one day Jim [Doyle] said, 'We got to do something about this.' So we got on our body armor and got together our slides and he and I took off and assaulted 30 Rockefeller Center, the CEO of the corporation. And we came out of there unscathed, but we also came out with a whole different attitude and a reversal of the behavior of corporate for the AEGIS program.

"Just two officers going and talking about the seriousness and the necessity of it for the country. And that CEO, he didn't like it, but he bit the bullet. And even though he was anti-Vietnam and even though we didn't equate to an Elvis Presley record, we turned it around. I don't think either one of us could have done it alone. And I don't think we could have done it without significant dedication and passion with which we attacked it."

MR. HAWES: "At least you made the effort. How many officers today would have made the effort?"

RADM MEYER: "Right. There's another point I would like to leave here for the record. There is one unique dimension to the Project Manager. And that is that only the Project Manager can raise money. He has a duty and an obligation to raise money. He has the right to demand that all his elves, his contractors, his labs and such, perform. But they can't raise the money. It is his obligation to go get the money and then to spend it wisely.

"I, too, subscribe to the point made here earlier, that the price you pay for a few good people is you got to have a lot of them. There's five or ten percent. And you cannot easily go take the other eighty percent out and drown them. They all do a lot of good things, actually, when you think about it, but they're generally

pedestrian or supportive in nature. But those five or ten percent are the spark plugs that cause us to thrive.

"Well, I think that is enough for this session."

DR. COLVARD: "Joining us now by video link from Maryland is Dr. Alexander Kossiakoff. He can bring us the perspective of a unique institution in the history of Navy R&D, the Applied Physics Laboratory of the Johns Hopkins University. Dr. Kossiakoff was the laboratory's director during the period we're interested in, and is still active today as Director Emeritus. Dr. Kossiakoff, can you hear us?"

DR. KOSSIAKOFF: "Yes. Hello, everybody.

"Would you like me to address the outline that you put together? Would that be the best way, or do you want to pose questions? How would you prefer to do this?"

DR. COLVARD: "The critical era that we're interested in was from the beginning of the Applied Physics Laboratory up to the '80s. That's the era we're covering, because that's when the Berlin Wall came down and it was sort of the end of the Cold War."

DR. KOSSIAKOFF: "Well, I would hope that we would interact a good deal. I have some notes along the lines that you had outlined. I haven't composed a half-hour speech, which you wouldn't want to hear anyway.

"Going back to the beginning of the lab. The wartime years, I think, are probably before the time that you want to cover because that was a totally different climate for doing R&D. And the way things were done in wartime do not resemble at all anything what was done postwar, and particularly today. So I think probably the earliest period you want to talk about would be the guided missile era of the late forties and early fifties.

"That, again, in terms of the institutional relationships, is very different because actually the whole operation of the laboratory was more conditioned by the contractual climate, the Congressional climate, than any other thing. In the early days we had a situation where all contracts were 'cost-plus'. APL had responsibility for technically directing the associate family of contractors, which nobody would think of today as delegating to a non-government agency. And I think the whole new era of competition and contracting and a very legal way of looking at responsibility, which, I guess, came about in the fifties, changed very much the way we've always operated.

"And, of course, as time went on and APL became a member of the [Federal Contract Research Center] club, which was put under Congressional oversight, that ten years was, again, a very different climate. Since that time we've

managed to struggle between being a University Lab and now a 'University-Affiliated Research Center'. And I've got to say that probably the last ten years or so have been more benign as far as APL is concerned from Congressional pressure than it had been the ten years previously.

"You asked about the key factors that made APL successful, and I've jotted a down a few that are a little bit cliche-like, but, nevertheless, they're probably real. One was a total focus on the solution of operational problems and needs, rather than trying to develop a particular device or solve a particular research problem. research and developments emanated from the needs, rather than as objectives in themselves..

"Teamwork with government, industry, and academia, which started back in the wartime years, went on into the Section T and BUMBLEBEE programs after the war. And I think to a large extent it prevails today to a much more fragmented extent, but is still one of the rules we like to operate under. Another feature that I've taken particular pride in is that APL has, more than most organizations, challenged obstacles that stood in the way of worthy objectives. By that I mean, that we very often stepped out of traditional roles to undertake tasks that we really had no business to do because it seemed necessary to achieve an objective.

"This tradition started back in World War II when APL sent officers into the fleet to help train crews in the operation of the proximity fuse. And from time to time, we actually embarked on production engineering when we weren't supposed to, because it looked at that particular time that the problems with the early missiles were in how they were configured for production, rather than their other performance features. This caused APL to undertake a lot of missions that, again, we weren't supposed to originally. For example, the space mission was something that came about rather accidentally and has become one of the main laboratory missions.

"Another key principle has been not to consciously compete for work. It wasn't our policy not to compete because of any reluctance to do so, but just because we had enough work to do that it didn't seem to be useful to try to do something that another organization could do as well or better. I think today's climate is much more competitive, I would say, as far as all organizations are concemed. But in the early days competition was not something that we engaged in willingly.

"You asked what we consider to be competition. In those days we really didn't consider that we were competing, except possibly on occasion with competition for ideas. And the only organization that comes to mind as being in that category might be China Lake. APL and China Lake have had a lot of similarities in that both laboratories were basically system-oriented. And the thing that kept us from competing perhaps more in the way of ideas was that were we oriented towards

the defense of ships, and China Lake was oriented towards arming aircraft. Otherwise, we've considered ourselves as similar organizations.

"You asked about the obstacles we encountered. I think I mentioned the ones that were most noteworthy, and those were Congressional pressures, which kept the laboratory pretty well at a fixed level for ten years. Actually, we accommodated reasonably well to that, but it was always a threat when the new Congress came in. Always, one or another Federal Contract Research Center did something to offend Congress, and they would slap a five-percent cut on all FCRC's. So we would find, all of a sudden, that we had to extract a sizable chunk of funding from our projections.

"As far as help, of course our Navy sponsors have been the principal source of help for the laboratory. In the old days, the Assistant Secretary of the Navy for R&D was someone that we considered to be a sponsor of the laboratory. But that has pretty radically changed in recent years.

"I'd like to raise a few issues that I think are worth thinking about, and these are issues that I know many of you have considered and debated and worried about. They have to do in part with the decline of the leadership of the uniformed Navy, which started way back when DDR&E was first established and has developed over the years, mostly because of Congressional actions.

"The decline of the technical officer Navy is another great, complicated issue, particularly in the technological warfare that we find ourselves in today. I think the rules for competition for large-system contracts are in need of repair, and, in fact, the whole acquisition reform movement, I think, has some good points but has a lot of wasted motion in it.

" don't see any of those issues turning around. And they've been with us for quite a while.

"If you want to pursue any other particular topic, go ahead and raise it or just let me sit in for a few minutes on your deliberations."

DR. COLVARD: "Let me make a couple of points, Dr. Kossiakoff. First of all, I think you know all the people in the room: Admiral Doyle, Dr. Berman, Dr. DePoy, Admiral McCarthy, Mr. Hawes, Admiral Meyer, and Dr. LaBerge. Let me give you a summary of some of the key points we talked about in our discussions this morning and get your reactions and response.

"A couple of things that have been recurring in everybody's recall and discussion is the absolute necessity of technical competence at all levels in the institutions that perform research and development and in the production engineering. And technical competence in the oversight group, the Program Managers.

There has been a consistent theme of the value of a sustained effort. And I would phrase it my term, not theirs, of almost zealotry, typified by the coalition of institutions around surface warfare and OpNav with Admiral Doyle, and the programmatic side with Admiral Meyer, and the institutional side with APL, Dahlgren, RCA, and General Dynamics. That team and the continuity of that effort over a period of time was, I think, considered to be a critical characteristic of the era.

"Do you have any comments or thoughts relative to those two points?"

DR. KOSSIAKOFF: "Well, as far as the technical competence of both the leadership and the practitioners, I think that's a vital point. The only contribution, I guess, that I've had the good luck to make to that is trying to offer system engineering master's program to the Navy officers and civilians at Crystal City. We had, last semester, forty-three students there, exclusively Navy. And they seemed to have enjoyed the courses, and quite of few of them are going on to a master's degree. We think that's a very healthy sign.

"But that's only the tip of the iceberg. I think there has to be an institutional change in thinking beyond what's taken place so far to really bring about the kind of raising the levels that you're talking about."

DR. COLVARD: "You and I and Dr. DePoy had talked a little bit about collaboration between the Postgraduate school, and Johns Hopkins in the system engineering arena."

DR. KOSSIAKOFF: "We'd be delighted to pursue that."

DR. COLVARD: "I don't want to speak for all of us. Do the people at the table have some points or questions?"

DR. LaBERGE: "Could I ask you, was is it a myth, or were there really in the olden days a bunch of civilian giants that influenced the Navy in a way that doesn't exist today? Today, it's hard to count the civilians who really influence things. Was it because you were all that good or because you were well connected or how come?"

DR. KOSSIAKOFF: "I don't know. Of course, as far as the lab was concerned, Merle Tuve was really a civilian giant. He had the intellect and the will that was pretty hard to match. And I think he influenced the Navy a great deal on a personal basis and backed it up with technical achievement."

"I think those of us who followed did our best to just keep carrying the flag. I think there was a mutual respect between Navy leadership and ourselves that made a lot of difference. I think over the years that was the reason we've been as successful as we have."

DR. COLVARD: "Dr. LaBerge made the point earlier that a lot of Naval officers went through China Lake. It was my observation that a large number of Naval officers in the surface world went through APL, and as a result, got an acculturation or an association that influenced them through the rest of their careers."

DR. KOSSIAKOFF: "Well, Mark Woods was one that I know for sure was among those."

RADM MEYER: "It was a back-ended thing that happened with APL because in the early days of shipboard missilery, the Applied Physics Laboratory elves were all over the ships and in the ships. So the officers got this intimate identity with people from the lab. And their take-away when they moved into the system was to respect the laboratory and trust people on a personal basis. It was the interpersonal interrelationships which developed."

DR. KOSSIAKOFF: "Well, actually, the SMS project that, I think, Wayne is referring to, was a pretty hard row to hoe. But it did the laboratory a lot of good because, as he pointed out, it caused us to send dozens and dozens of people aboard ships to actually, by hand, fix the radars that didn't work and the computers that didn't work, and learn the ship system business firsthand."

"And we were really a team with both the contractors that were supporting the equipment and the Naval officers that ran the ships. And Eli Reich was a tough taskmaster, but he did a pretty incredible job. And, of course, Wayne grew up in that environment. One of the things I remember was persuading Wayne to steal a search radar from some depot up in Massachusetts and ship it to the lab so we could get into the search radar business."

DR. COLVARD: "Are there other questions from the assembled group?"

DR. LaBERGE: "Are the old days reversible? Can you get back to them? Do you want to, or not?"

DR. KOSSIAKOFF: "I don't think they're reversible, unless another war comes along or something close to it. There were a lot of good things about those days, but I don't know how to answer that question. How about you?"

DR. LaBERGE: "Well, one of our problems is that the acquisition corps in principal ought to be helpful, but turns out to cause the senior Navy to no longer have the chance to have any association with technology because you let the acquisition corps people run things. So you've walled off the uniformed Navy from technology. And it's hard to get the associations you talked of."

DR. KOSSIAKOFF: "Yes, I think whatever reversal happens would have to happen at high levels because it's the whole system of responsibility between the Naval officers and civilians and the lawyers and the Congress that I think has gotten askew."

VADM McCARTHY: "I have a question, Dr. Kossiakoff. Do you have any specific ideas on how to bring the pendulum back the other way?"

DR. KOSSIAKOFF: "I wish I had. I think if there was anybody inside the government that really understood how these things work and why, and had authority to make changes, that's about the only way I can see it happening. Because right now it's run by some kind of philosophical assumptions as to how it ought to be run and it doesn't work."

RADM MEYER: "What do you see ahead in the matter of Ballistic Missile Defense? Do you think it's important? And what do you think about the structure that we have contrasted, to the era that Walt has mentioned to take it on?"

DR. KOSSIAKOFF: "Well, that's a hard thing to answer because it changes every day. I guess the Navy is going through some fairly major changes of organization and assignments and everything. So I'm not really close enough to the way it's being managed to make a comment. It's certainly an important program, and it's going to be important for some years. I think there's some talk of running it very much like the POLARIS program was run in the early days. I'm not sure you can recreate that, but if you could get somebody like Wayne or Levering Smith to run it, it might work."

DR. COLVARD: "You get back to the criticality of leadership."

DR. KOSSIAKOFF: "Yes."

DR. LaBERGE: "Could I try you on a question of your confidence? What's the future of ship defense? Is the offense going to win in the next ten years or twenty years or is the defense? It's important here because we actually have a bunch of people who are studying small carriers on the assumption that getting lots of small carriers is sensible because you can't defend a big carrier. I believe, personally, that's nonsense. You're only down by three or four db in cross section when you need a thousand. But can ship defense survive?"

DR. KOSSIAKOFF: "Well, you know, ship defense was declared dead back forty years ago, as I remember. And I guess when the Soviets were in full sway it was pretty optimistic to think that you could repel that kind of force. I remember Bill McLean never gave ship defense very much chance. With the end of the Cold War, for the first time, I think ship defense looks pretty good. If the enemy is small enough, we can beat the hell out of them. But as long as we have the kind

of enemies that seem to be out there, I think we can keep the carriers afloat, whether they're big or small."

DR. LaBERGE: "Do you get a chance to argue this sort of thing? Is there a top-level discussion of what the future is going to be like, and what is going to dominate it, that you participate in?"

DR. KOSSIAKOFF: "I haven't seen that kind of an argument for a long time. There may be arguments like that, but I haven't been involved in them, and neither have, I think, most of my colleagues. They must take place in Naval circles, certainly. I should think. But I don't know anybody outside that's been arguing that."

DR. COLVARD: "Dr. Kossiakoff, you must be rightly proud of your institution's accomplishments over the years and your own personal accomplishments. What are the one or two things in your mind that you are proudest of that came out of the Applied Physics Laboratory?"

DR. KOSSIAKOFF: "Well, the proximity fuse, of course, which happened before my time, is what started the place and that was probably the most valuable accomplishment of the lab, at the time."

"I think Transit was quite an accomplishment. That was a combination of luck and innovation and being in the right place at the right time. My own part that I like best was getting us a step farther out from the weapon system into battleship coordination into things, like, CEC and trying to get the battle force to fight as a unit based on all of the technology that was in AEGIS and related weapons. The NEAR satellite's a pretty neat thing. I've never tried to count them, really. Now, I can't take any credit for NEAR."

DR. COLVARD: "I wasn't trying to limit your ability. I was really sort of interested in the kinds of things that you think the laboratory uniquely contributed to. In other words, the institutional environment of a research-capable institution that really is an engineering entity?"

DR. KOSSIAKOFF: "Well, I think the thing that, in part, distinguishes the lab from many others is the system focus, trying to solve a total problem, or at least a large part of a total problem, rather than would work in a field of componentry so to speak.

"And I think that we've had our greatest success by contributing to a growth in system capability and a real product rather than just an idea. And the end-to-end capability from idea to a product is what I think we've been good at. Actually, the product end is the part that gives us the most trouble because that looks like we're competing with industry, and industry doesn't like it much. Their sponsors in the Navy don't like it much, and we get beat around the ears a good deal for

trying that. But still it's, I think, the only way you can demonstrate a new capability. You can't just wave your arms and show view-graphs. You have to build something."

VADM DOYLE: "You mentioned battle group AAW coordination, which, of course, is a foundation of CEC. And now there seems to be a feeling in the Navy that all problems can be solved by 'network centric warfare', whatever that means. It really hasn't been defined. But it seems to me that's generated a great deal of confusion between the data and the communications that go into command and control; the difference between that and fire control and closing the fire control loop. Are you getting any impressions like that?"

DR. KOSSIAKOFF: "Well, yes, of course, but I have sort of a fear of getting into systems that are more complicated than anybody understands. The difficulty with network centric warfare is that at some point you become pretty vulnerable because of both complexity and the possibility of intrusion.

"I'm not arguing that we shouldn't push in that direction, but I think there's been, perhaps, too much faith in network centric warfare solving all the problems. I think it's going to take a tremendous amount of effort and a lot of brains. And here, again, there's a need to expand the technical knowledge of people that are going to operate these things and maintain them, because as I think as everybody knows, complex software is pretty fragile."

DR. COLVARD: "Are there other questions?

"Well, Dr. Kossiakoff, I'm delighted that we could add you to the group. Unless somebody else has a question, I'd like to thank you very much for coming in at the end of your workday. Is there anything you'd like to ask us?"

DR. KOSSIAKOFF: "I'd like to find out what the next step is. In other words, you're going to collect a lot of thoughts, a lot of issues on the table and you'll record it. When's the next meeting of this group?"

DR. COLVARD: "This was the first and final annual."

DR. LaBERGE: "Like all groups, we're in disappointment and disagreement. I believe we're about to see a reemergence of the arsenal system just because we cannot get a competitive base of suppliers that we have had up until now with the budgets we have had. And that we're likely to see concentration in the laboratories again of authorities they used to have just because you can't get it now in a supplier base.

"So from my perspective, how should we do the laboratories over again, if in point of fact, this is the way it's going to go? Do we do it the way we did last time or are there some things we ought to do differently?

DR. KOSSIAKOFF: "Well, we must have learned something, and we probably shouldn't do it exactly like we did last time. But that's a big question. You have to create a scenario and fill in all the environment in order to answer that question, I should think."

DR. COLVARD: "Let me answer your question about what's next. We are going to complete the recording here this afternoon of the discussion among this group. We will then have a video tape history of these discussions, including yours. We were able to record you as a part of it. And then we will publish a report about the summary of the key points of this discussion, and we'll make the videotape available to people who want to use it for historical purposes, to look back at the opinion of leaders in the field during the Cold War. We did not have the intent to create a chowder and marching society that would meet regularly.

One of our guests has a question."

GUEST: "Dr. Kossiakoff, there has been a good deal of discussion comparing things today and a few years ago, and in particular leadership of people. I guess my question is: Why does somebody come and work for the Applied Physics Laboratory today? What's different between why they come to work with you now than they did ten, twenty, thirty, or forty years ago?"

DR. KOSSIAKOFF: "They come today for, I think, much the same reason that they came to work for the laboratory twenty or thirty years ago. I think the Hopkins name is a major attraction. I think the laboratory's record is a pretty good attraction. They can read about us in the papers and magazines. It's a pretty noble mission. It's a public service mission, which still attracts a few people. There's some pretty challenging, technical work to be done. There's not as much freedom to do it as there used to be, but relative to other organizations, it's still pretty good. There's a pretty good record of continuity of employment as compared to industry, for example. I would think that it's still a pretty healthy attraction."

DR. COLVARD: "Any other questions? Again, Dr. Kossiakoff, thank you very much."

DR. KOSSIAKOFF: "Well, I feel it a privilege to have participated in this. And I would be happy to hear about any results that come out of it."

DR. COLVARD: "We will make sure that you get a copy of the tape and also a copy of the report. What we hope to do before we issue any kind of report is let the participants take a look at it, make sure we haven't misstated anybody's positions. So you'll get a chance to see it. Thank you very much.

"Okay. Let me wrap up as the final speaker.

"My background is as the technical director at NSWC, Dahlgren and as the Deputy Chief of the Naval Material Command. Let me speak briefly about my perceptions during that era.

"I came to China Lake as a young engineer and spent the first ten years of my career there. There were several things that struck me, and I've often wondered why it was so productive. And it was.

"One of the things that I saw that characterized China Lake was a very, very high level of trust. For example, when I came in as a young engineer, in those days we didn't have offices. We had benches and toolboxes. And they told me, go down to the pre-expended small stores and draw two sets of tools, one for yourself and one for your workplace. Because you live on the base, that's government property. We know you're going to take tools home, and we don't want you ever to be without a tool when you need it to do your job.

"Can you imagine today with the waste fraud, and abuse mentality, of that level of trust or the fact that you're going to behave as a responsible professional which they hired you for? So I was struck by that, the fact that they trusted me when I walked in the door. And you worked hard not to betray that trust.

"And there also was a close association between the abstract and the real -- all the way from the idea to the ultimate weapon and the feedback from the warrior about that weapon. As a young engineer, I could come up with an idea on a piece of paper and walk next door and talk to a grizzled old machinist who could say, 'Well, son, that might work. But here's some things you could do to actually make it work.' And we could come up with something that went from an idea to a working piece of hardware, which we could then ultimately take out and fire on the test range. So in one location, you had the spectrum from an idea to a product.

"And the linkage between humans was what made that very complex transfer of knowledge occur effectively. When we began to contract out the machine shops and stuff, when we began to separate and remote the process, the character of the institution began to change. Once you had the weapon and you had it deployed, now you had the squadrons come back and tell you where you had made mistakes. They gave you very candid, graphic, and critical feedback about the product that you had put in their hands -- that they had taken out to risk their life with.

"To me, whether it had been China Lake or anywhere else, the fact that you had that level of trust, you had that association between humans, where there was transfer of knowledge and a trust level that allowed you to get a lot of things done. The kinds of people that I remember dealing with in the early days in the headquarters who were very up on it were, maybe some of you recall, Dr. Frank

Tanczos. In the world of exploratory development within the Navy, he was kind of weird, but he was a major supporter. He knew how to work the system. He and Justin Malloy were guys who could get things done. They were in the classic, positive sense of a bureaucrat, a person who knew how to turn the needs of reality into support from the institution. You respected them. They didn't know the engineering as well as you did, and that wasn't their role. But they got things done.

"And guys like Don Saulpaugh and Captain Stan Gary. These were people that knew you. You knew them as friends. You worked with them. When you looked at some of the strengths at the laboratory, I think a lot of them had come out of the Cal Tech era. And they were there probably because of their commitment during the war, but they stayed on. So they gave you an intellectual nucleus around which the institution could coalesce, guys like Highberg, Knemeyer, Hack Wilson, of course, Walt [LaBerge], and others.

"Those with whom we had great difficulty included what I considered to be a sort of a classic case of the problem of bringing two cultures together. Admiral Art Gralla, who was head of Bureau of Ordnance, came out to China Lake. And he reviewed a digital fire control program that I was in charge of. And at the end of the review we sat down in a conference room. And he said, and this is as close as I can remember to a quote: 'This is the finest program that I have ever reviewed. And I'm going to move to it Louisville because I no longer sign your commander's fitness report.' And I was just devastated that a mature, adult professional could say, my ability to command exceeds my interest in solving the problem.

"I've never forgotten that lesson, and I guess the rest of my career I worked to take the authority that he literally possessed and somehow turn that into an appreciation for and a utilization of the technical talent, which can't be commanded. You cannot command peoples' thought processes and try to make the command culture of the military work effectively with the ideation/discovery culture of the scientist, who is not concerned about what your rank is but about what you know.

"And I also felt very strongly that if we were a Navy institution, a proper solution to the problem wasn't to scream at the military, but to recognize the challenge of performing in such a way that they saw the value of the association. But to me that cultural association was one of the things that laboratories like Dahlgren, China Lake, and APL produced -- that they could bring together the scientist and the sailor in a complementary and mutually respected fashion. It was one of their products that probably was worth as much as any hardware they actually invented because if there was mutual respect, then the decision makers in the program offices could effectively utilize the people.

"I believe that in working, for example, between Dahlgren and with APL and with PMS-400, we built such a working relationship because you could find military officers, in this case Admiral Meyer, who understood that. But I never forget that lesson of listening to Admiral Gralla.

"Then, as Technical Director at Dahlgren, I watched Admiral Freeman destroy China Lake because of his interests in commanding it, rather than leading it. And his interest in proving that the politically correct movement of the times, fueled by, among others, Admiral Kidd, for whom I had a lot of respect but who knew nothing about managing technical institutions.

"But Freeman, who may or may not have been well-intentioned, literally came in and crushed a treasure of the Navy that was a very fragile institution. It takes a long time to build a stable and effective institution, but it can be destroyed almost instantaneously. And I'm not suggesting in any way we go back to the China Lake days. I'm saying as an institution it had the features that represented the critical need. A critical need to the Navy was crushed because of a misguided sense that getting it 'under control' was more important than having effective products.

"When I was at Dahlgren as the Technical Director, I watched that institution, which had been a river range, grow into a reasonably balanced R&D institution. And it was based on understanding the fundamentals. And it was not my effort of which I speak. Barney Smith and others had more to do with it than I did. The fundamentals of calculating a projectile trajectory was the basis that allowed Dahlgren to eventually get into the fleet ballistic missile world and into the AEGIS world and into computer programs. And the focus on technical excellence that you talked about here all morning was the thing that we tried to build that institution around. And we tried to determine what was its proper role, and we avoided expansion beyond the needs and interests of the Navy.

"Let me give you two examples to illustrate the point I'm talking about. We transferred the A-6 software support program from Dahlgren to China Lake over the violent objection of Captain Alexander, who said, 'You're doing a fantastic job, and I will not have this.' We guaranteed, out of our overhead, that we would send a team to China Lake to insure there was no spillage in the transfer, because it didn't make any sense for us to be in the air support business when the Navy had another institution with that capability. We also transferred the Cartridge-Actuated Devices work to Indian Head, which stabilized Indian Head over the years, and it freed up resources to allow us to take on another direction that made more sense to the Navy.

"The point of that soliloquy is to suggest that there was a time when the institutions tended to cooperate more with each other and not necessarily compete with each other, to steal the work and that sort of stuff. These are examples of the reality of that cooperation. It has become less possible to do

that. As the competitive environment has changed, institutions are now out trying to get into each other's pockets in order to stay alive.

"Dahlgren was, and is, an interesting engineering institution that happened to have the right time cycle. They almost went out of existence, and then came a time when the very thing the Navy needed was computation and analysis capability, and modeling and simulation sustained them and integrated them as part of the team. I can talk about the things that Admiral Meyer did to stabilize that institution, but what has given it stability today was the fact that, as you talked about this morning, the institution became a part of the team. And while the master for whom you worked demanded performance, he accepted the obligation to raise funds and support you. And that allowed Dahlgren to stabilize.

"Let me make a few comments about NavMat. I went to Materiel Command headquarters to be, as it turned out, the first and final Deputy Chief at NavMat. The institution was closed in 1985 by Secretary Lehman. I went up there in 1980 with the very explicit objective of building a complementary relationship between the military and the civilians in order that when the day came when we had more civilian Program Managers and you could see that day approaching that they were prepared to accept that role, to take on that role and play that role because we had not previously developed people to be able to do that. We had good technical people, but we didn't have people who understood the combination of technical, social, and political dimensions of running a big institution and being a Program Manager.

"NavMat was universally revered as the people who could light up a room by walking out of it. The Systems Commanders felt very strongly that when the day came when they got rid of CNM, that would be like the end of slavery.

"I remember talking with them at a breakfast right before Lehman decided to close it in which I said, 'You will lose your buffer. The thing about a Materiel Command Chief is that he is in the same service you're in, and to him it is a vocation. In exchange for that, you will receive political leadership to whom the job is another stop on building a resume. However well-intentioned they may be, and however bright they may be, whether it's a Dave Mann or a Dave Potter or a Ty Marcy, whoever is the Assistant Secretary of the Navy at the time will become the de-facto Chief of NavMat. You will have traded one master for another, but you will have traded an understanding master, who has shared your experiences and who shares your values, for one who does not fully understand your role, nor appreciate it, nor who will be responsible for it in the long-term.'

"And, certainly, that has occurred. And I'm not here to compare the good old days with today. But there was a role that NAVMAT played as the flag around which you could rally when you wanted some cover. The value of having cover was mentioned this morning by Admiral Doyle.

"Those people who understood that role played it very, very well and used it very, very effectively. Other people wanted freedom, and I'm sure there were many celebrations the night that it was announced NavMat was closed in which everybody sang 'the witch is dead, the witch the dead.' But sometimes, as they say, be careful of what you wish for, you may get it.

"I began to see the politicization of the process, starting with the Lehman era for whatever reasons. And it turns out some of them were nefarious. You began to see the transition of power and decision making authority from the hands of military officers to whom this was their life, their career, and their Navy, into the hands of political appointees.

"I thought that the NavMat years were very educational for me, coming out of the field. And I felt that I learned a lot from watching the process, and I also found that you have to be prepared to put five years of your life into something and then watch it flush down the drain with one stroke. I spent five years helping build a mutual appreciation between the military officers and the senior civilians.

"I was the detailer of the Senior Executive Service. We moved 150 SES out of the 350 in five years. We started the process of managing the careers of the civilians, of determining what they needed in a way of experiential development, as well as academic education, preparing them in a more career-oriented sense for the roles they should play as complementary leaders in the Navy acquisition process.

"We had a series of meetings in Washington. We had dinners regularly in which we would invite all the flags and all the SES. We had the CNO speak, the Secretary of the Navy speak, various people from the Joint Chiefs speak. And over a period of time we began to build in those two communities an appreciation from working together, not lecturing to each other, of mutual respect.

"Now, there's always a reasonable distribution of jerk-to-jewel ratio in society. So not all of them were winners on either side. But at the end of that five years we had a program that was moving very, very effectively. Then Lehman decided he would make it mandatory. He asked me to run it, and I said I could not in good conscience do that with people who have respected me and trusted me over the years and, therefore, I requested that I be allowed to leave the Navy, in retirement. But the point is, I'm talking about institutions of that time, and, again, I don't want to go back and rebuild NavMat. But there was an institutional process, in which understanding and trust, which, in my opinion, are key to effectiveness were built at the top level as well as down in the laboratories.

GROUP DISCUSSION

[Following the presentations and observations of the individual participants, the group as a whole engaged in a roundtable discussion.]

DR. COLVARD: "I was interested in listening to all of the discussions this morning and I think there were some common themes that have developed."

DR. LaBERGE: "It seems to me a crucial difference between Wayne and the POLARIS/POSEIDON in the laboratories was that you knew Wayne was going to push AEGIS and the POLARIS people were going to push POLARIS. The laboratories used to be an honest broker, or at least tried to be an honest broker."

"That went away with institutional funding going away and your having to go to grubbing for money and like any other grubbing for money, if you don't do what the customer wants and support him, you don't get any money. So from my perspective funding of the laboratories dominates whether they can be an honest broker or not. Did you see that?"

DR. COLVARD: "Sure. In fact, now they've even done away with IR and IED money. That's been long since gone. My observation of several major trends that, I think, defeated the purpose and were in not the best interest of the Navy in the long haul. Such as when we moved the 6.2 money over to ONR. Unfortunately, I was around and agreed to that process, so I can't blame somebody else. And the thought was we'd improve the coupling between research and exploratory development. Instead, we wound up taking all the money out of the laboratories. It stabilized NRL, but it screwed everybody else. And more importantly, it turned ONR into, essentially, a Systems Command."

"When I used to recruit people at the PhD level, I'd ask them, 'Why are you interested in the Navy?' And they would say, 'Well, you know, when I was doing my research, I was struck by the number of projects that ONR funded. And any organization that's that willing and understands the need for investment and research can't be all bad. And so I'm interested in working for the Navy.'

"So the idea of putting investment money into an institution that allows it to generate the knowledgeable people began to go away and everything is now measured down to the fraction of the penny and overhead becomes the major driver. When we had modified Naval Industrial Funding, you had a certain amount of institutional investment. You went away from that, then you had a certain amount of independent R&D funding that the Technical Director had control of."

DR. LaBERGE: "I've got a question for Wayne, the military officer. Why should he go to a bunch of civilians that are grubbing for business in the same way that the industry they complain about is grubbing?"

RADM MEYER: "Well, that's a first-class point. I was ordered into the Special Navy Task Force in 1963. And I had come from being gun boss on the cruiser GALVESTON and also the converting fire control officer. I found that I was diverted, literally, by Admiral Reich as I was walking down the passageway, to the TERRIER fire control desk, rather than the TALOS fire control desk, which is where I was headed to. And in the two years which followed, in that era, a commander like me and, say, a GS-13 in that process would have control over four or five million dollars.

"I just got infuriated where this deterioration was setting in. At that time I did not appreciate what was happening to the laboratories, because it was far above my pay grade of how the McNamarian forces were starting to manipulate this money away from supporting these laboratories or supporting their independent integrity.

"So laboratories were starting to get money by WEPTASK, in that era, out of people like me. I was at that desk. And what had really angered me about them was, you'd put a WEPTASK in a laboratory and POOF! POOF! It just sailed right off into the ether. But you could get your contractors in there and say, Hey, Ralph. I want this, this, this. 'Yes, sir. This is the way we'll do this.' But if you sent it to the laboratory, POOF! It just sailed clear out of sight someplace.

"What finally broke my back was the Naval Fuse Lab at Corona, California. Why on earth were they in the range tracker for the SPQ-5 radar? They were working on a project, on fixing the tracker in a SPQ-5. And it was my money well, not my money, but I was the steward of it. But it just disappeared. And I couldn't even get them to give me a report.

"So, I said, 'Well, I'll fix your wagon.' WOOF! I did the woof horizontally. And I vowed that I'd never put another nickel in a laboratory again, if I had anything to say about it. And I removed any money that I had granted, an insignificant amount but I removed it from the laboratories. I never returned to the laboratories until many years later when Jim Colvard as the Technical Director came rolling in one day with his Commanding Officer from that place called Dahlgren, and started pleading with me that if I would start forming a relation with them, they would also return a relation.

"So we made a pact. And what has resulted from that, which is now two decades or more older, is you have a big Wayne E. Meyer Education Center in Dahlgren, you have the AEGIS Computer Center in Dahlgren, you have the gigantic Wallops Island complex, which supports Dahlgren, plus all of the other associated AEGIS work, which they do, which was a direct result that flowed out of that when I went back to the laboratory.

"But the conditions now, as you point out, have irreversibly changed. They have irreversibly changed."

DR. LaBERGE: "What do you think about it? His answer has to be great because,
otherwise, he doesn't survive."

RADM MEYER: "Right. The world changed. And like Jim said earlier, I was a party to it, in a sense. I don't know whether it's preventable."

VADM McCARTHY: "Let me pick up on Wayne on that and doing business with the laboratories and define my relation with McDonnell-Douglas. We really tried to do that. Tried to do it in the Joint Strike Fighter program. We tried to do it in F-18, the "F" program. One of the fundamental problems that you have with an outside institution such as GD dealing with the laboratory is that there's no liability. If you give them a work task and they run out of money or run out of hours, that's it. So you don't have the answer, you don't have the paper; you don't have the product. You know, try and go in to your boss and explain it."

DR. COLVARD: "By the same token, Admiral, you don't have..."

VADM McCARTHY: " Wait a minute. I'm not done. You know, that's a very difficult explanation. So the next time it comes up, you don't do that because you recognize what happened the last time. Go ahead."

DR. COLVARD: "I was going to say by the same token you don't have a lawsuit for overruns and claims."

VADM McCARTHY: "Sometimes you make money on those, Jim."

DR. COLVARD: "Of course you do."

MR. HAWES: "Can I pull that string a little bit?"

DR. COLVARD: "You can certainly pull it as hard as you want to. We're in the cross-talk mode now."

MR. HAWES: "I mentioned earlier on that General Dynamics/Pomona had a very good relationship with the laboratories with one exception and particularly with APL because in the early days, back in the days of DPN-24 Seekers and HT's and IT's and TERRIER's and things like that, APL was the engineering force that drove the Pomona division. Now, as new engineers in Pomona came online, that got to be a little bit testy after a while. And that situation was changing from one of almost total cooperation. So I had spent a lot of time out

there in trying to marry a missile and a radar with Raytheon with people, like, Hank George, et cetera.

"One single event changed that. That single event was TYPHON. And Pomona did not get back to a strong relationship with APL until Admiral Meyer came along, with AEGIS, and redefined the role. Because what TYOHON did was change the role from friendly, working together team, to competitor. We viewed them as an absolute competitor. When I worked with Marty Borowsky on the downlink receiver my real job was to be a spy for General Dynamics, to find out what was going on in the laboratory. That amount of mistrust had built up.

"When Wayne came along on AEGIS he had to rebuild that. He rebuilt that by the force of his own personality. But more fundamentally, he redefined the role that APL was going to play. It became an acceptable role to Pomona and after that, the relationship rebuilt."

DR. COLVARD: "You've got real challenges in any process, but certainly in the R&D process. When the problems are only understandable by the person who possesses esoteric knowledge and experience, how do you generate those people? How do you stay technically capable to go out to industry and know that you're going to get what you asked for, and that what they propose is reasonable?

"You can never contract out the ability to understand the military problem in the technical terms or to know who could solve it, or to recognize a correct solution when you get it. To do that, you must have technically competent people who are continuously available to you, who cannot go out of business because they're not making enough money. Whose only motivation is to tell you what they believe to be right, and they have to know a high percentage of the time what the laws of physics will permit. To generate that talent, you have to invest. Quite often the payoff isn't realized until the long-term."

RADM MEYER: "Right."

DR. COLVARD: "And when you have no institutional funding, who pays for that investment? The Program Manager doesn't want to. He's got to get his product out the door, meet his schedule, meet his dollar cost."

DR. BERMAN: "There's no way you can pay for it any longer, is the simple answer."

DR. COLVARD: "I don't care whether they're called civil servants. That doesn't matter to me. If you're going to go back to arsenals, the monopolies that are building today in industry may be your in-house institutions of the future in the sense that they are not competitive and they won't go out of business."

DR. BERMAN: "Any sheltered workshop is not competitive."

MR. HAWES: "Right now competition is gone. You don't have any competition. Don't kid yourself. That's gone. You are now moving very rapidly to a monopolistic environment. As far as I'm concerned, the Navy's issue, or the government's issue, is how do you choose to gain, and then exercise, control over that situation? You no longer really control the evolution of your ordnance."

DR. COLVARD: "And you can't control something you don't understand."

MR. HAWES: "Well, you better start understanding Raytheon.

"So the issue that I see and I'm speaking from an industrial perspective, since I'm not in that marketplace any longer, the issue for the Navy and the government to a certain level is to decide how are you going to gain control over that? Because you do not now have control over it."

DR. BERMAN: "Raytheon is our arsenal, for all practical purposes."

MR. HAWES: "But right now it's an uncontrolled arsenal."

DR. BERMAN: "Oh, yes."

RADM MEYER: "Not only that, the shift that has occurred here. I'll call it the MBA attitude but that may not be quite correct. But back in our past the great corporations had some first-class laboratories. We all recall in our lifetime some great laboratories that existed across the country.

"Well, in this name of efficiency and profitability, this heart has almost disappeared on the landscape. You've really got to be a forward-looking CEO to be making any investment for the sake of studying why grass is green or any other things of that nature. It is just not there."

VADM DOYLE: "This gets back to the point Jim Colvard raised. Speaking from the standpoint of generation of requirements, and the translation of those requirements into engineering specifications, where is the technical safety net that the Navy needs?"

VADM McCARTHY: "It's industry. It's not in the Navy."

VADM DOYLE: "It's not in the Navy. That raises the issue of trust, again."

VADM McCARTHY: "What you see happening in the Navy budget is that while they laid off an awful lot of people in the NAVAIR's and the NAVSEA's and the rest of that what you see coming up the other side is a beltway-bandit load that comes up on overhead. So what you're really doing is replacing one structure

with another, and these are people that you can buy to look over your RFP or to tell you what you think the right technical answer is and try and do some sorting."

DR. BERMAN: "Replace Crystal City with Tysons Corner. Simply put."

DR. COLVARD: "But there's a critical difference. Let's take one example, looking in our past. Ralph talked about the NIROP. Most people didn't even know what a NIROP was, but it was a Navy Industrial Reserve Ordnance Plant. They were operated by, and later were an integral part of General Dynamics. And General Dynamics decided the defense business wasn't going to make enough money and went out of business, sold it, and then Raytheon moved it up to Tucson.

"And you lost, probably, sixty-to-eighty percent of the intellectual residuals of a multibillion-dollar investment the Navy had made in that process and in those people. And whether you like a China Lake or a Dahlgren or an APL -- APL is a slight exception although they have a trust agreement with the Navy -- they cannot choose to go out of business simply because they're not making enough profit. They can't decide it is time to walk away from this puzzle because we make more money crushing rocks or selling Elvis records.

"The point is that it is not sufficient for the talent to exist. The talent must have an institutional and vocational commitment to the Navy. The Navy, as a current institution, must control the decision as to what to do with it. You don't do that in the private sector.

"Now, you obviously don't want to buy the manufacturing arm and own it and everything else, so it depends on where you say the unique Navy function and govemmental function will end and where the private sector competitive function will begin."

MR. HAWES: "What do you mean, 'competitive'?"

DR. COLVARD: "Well, let's say for the sake of historical argument, in the days when we were active, what you got out of the private sector was competitive; people competed to make some money."

MR. HAWES: "But it's a very different world now."

DR. COLVARD: "I agree. I'm not arguing with you. I'm just saying, since it has changed, you may have to bite the bullet and own the whole thing."

DR. LaBERGE: "You know, another fundamental thing that has happened is that DARPA has essentially taken over the institutional funding. If you look at where the free money is, that goes on new ideas as opposed to detailed engineering of existing stuff, almost all of it is in DARPA. And so DARPA sets what the priorities

are. The Navy doesn't feel that there's anything lost by going to them and getting the money, but that doesn't mean that it does what the Navy really wants."

VADM McCARTHY: "That brings up a very good point and one that I was going to touch on. You know, we talked about requirements. How you do requirements, how they are generated, where they are conducted.

"Walt talked about DARPA, but ONR is exactly the same case. ONR is not controlled by the blue-suit Navy. ONR is controlled by the Secretariat. So the list comes out that ONR plugs to OPNAV on an annual basis. What are your requirements? What would you like us to look at? Stuff comes back into them and they say, 'Well, that's fine, but it doesn't fit into the things that we're doing.'

"About seventy percent of the programs that they have are already locked up. And Hugh [Montgomery] was clever enough to get a little pot of money aside and we start working with 6.3A. But really, if you look at DARPA and you look at ONR, if you're an operator, you literally have to go and beg those people to get your programs done, to get your requirements done, whether it's a 6.2, 6.3, 6.3A. And DARPA is literally the same way. You know, the people in DARPA define the requirements, and then they go out and try and sell them and market them."

DR. BERMAN: "Exactly right. DARPA is a hobby shop of DARPA managers."

RADM MEYER: "When the Defense Science Board met 13 May, Aldridge said, amongst other things, 'We're going to up-tick DARPA 500 mil this year.' DARPA is going to get 500 mil, and, I thought, just what we needed. But he did make a declaration. Somehow we are going to raise the services to three-percent S&T. We'll see.

"Dr. Kossiakaff flung out a challenge there as only he is capable of doing. And that is: what do you people plan to do next?

"I would like to suggest there's some advanced thinking to be done here, where we started talking about this arsenal and our decay, if that's a good word, in our middle, in our technical prowess, and how we say it has moved to industry. And my assertion that the MBA mentality has set in where there's not any long-term investment in our part of the world in research or such.

"Now, if that has happened, if this is our situation, and a number of you made the point earlier today. Well, wait a minute. The common denominators in so much of this were our officers. So where are our officers? Well, most of them are off on some parabolic trajectory in 'jointness' or something. Let's take Tucson, as an example.

"Why aren't we casting thirty or forty officers into the system, just throw them in there, the way Colvard and I learned in another era with civil servants? Just

throw them in there and make them go down there and work for two years or do something. And why don't we throw thirty or forty in another place? If we are decaying to arsenals and if that is where we're going, are our officers really following, and is the Postgraduate School educating officers to do it? My own take is that's become very flaky, the education."

MR. HAWES: "First of all, it's not educating them. We're educating them wrong, in my view. Second, all your officers are in Washington D.C. trying to fight for budgets or answering questions, and nobody's out with the troops trying to get the work done. So they have little or no influence."

VADM McCARTHY: "Well, there's one thing I think has changed, though, Ralph, on that. Wayne is right on this. You've seen an awful lot of emphasis on jointness. And what do you do with the five or ten or twelve percent? We're recognizing that the road to success has got to be through the general staff because people get promoted down there. They get out and they do well. People who are in the Systems Commands and in OpNav now, are becoming the next tier down. They're doing well, but they're not the same kind of guys that were there ten or fifteen years ago. The guys that were there ten or fifteen years ago now are down on the joint staff, or on the joint commands."

RADM MEYER: "Right. Right."

VADM McCARTHY: "You've become a marvelous joint organization, but technically and from a programmatic aspect you're not doing very well."

MR. HAWES: " If you were to do what you suggested, Admiral Meyer, throwing in a lot of officers into Tucson with the current training and experience those officers had, my take is that within a matter of months they would be co-opted by the people down there in Tucson."

VADM DOYLE: "Well, one of the problems is that the Navy leadership that's outside of the materiel structure, that's either in OPNAV or the Joint Staff, doesn't understand what the problem is in the first place. I mean, this discussion would be all above them. They wouldn't understand what we've been talking about for the last day or so because they've been so far removed from what it takes to execute a program or what the steps are in the execution, in the engineering and so forth. They have been so divorced from that for so many years, that I think they'd be hard pressed to understand that there is a need to do something at this point. So the question is: How do we get the leadership educated and back into the materiel side of the equation?"

MR. HAWES: "That is a tough question, Jim."

VADM DOYLE: "But am I right? Do you see that?"

DR. LaBERGE: "Well, I believe you've only got so much time, therefore, you've got to look at how people spend their time."

MR. HAWES: "Right. What's the big payoff?"

DR. LaBERGE: "At the PG School, people stay for a year, and I don't know whether Bill Mayer is here as the physics department guy, but, you know, he believes in teaching them the intricacies of Schroedinger's equations. And my own belief is that a little of that goes a long way in the sense you learn it, not in order to become a physicist, but to understand how the thinking process goes."

MR. HAWES: "To be able to communicate."

VADM McCARTHY: "But I honestly believe that we misuse the education time we put in, Jim, in the way we focus on degrees because people want degrees so that in their second life they have those credentials. And I believe we overstress the academics to the point where you don't get a chance to do anything else other than offering the fundamental courses that you would get if you were just an engineering student someplace else.

"So I don't think you can stop the jointness, but I do believe we have people for a reasonable number of years in the process of education. We ought to really look at how we use that time."

DR. COLVARD: "Let me pull us back to digesting what we should cover in terms of what we saw when we were in positions of responsibility. We have gotten off into trying to solve the world's problems.

"We're not in a position to solve today's problems. The way we can help the people solve today's problems is to give them some insights into why things worked before.

"What were the fundamentals? Because that's what this group has that is unique. There are a lot of people today who are going to work on the problems that aren't ours. We're not responsible for them. I mean, we are obviously concerned citizens, and have a vocational commitment to the Navy. But I heard a lot of talk this morning out of which came some real strong fundamentals. We said that continuity made a big difference. We said that there was an association between the sponsor, the Program Manager and a close affiliation between the technical institutions and the industrial base that worked. We all also talked about the fact that the key to that was technical competence at all levels. Are there other things that we'd like to discuss, now that each person's had his say?"

DR. LaBERGE: "I believe co-location turns out to be an extremely important thing that we've lost in the period between the old days and today. The program office in Crystal City or wherever they've been banished to, just doesn't have the assets

available to them they used to have. Wayne used to get the people to be housed up in the RCA facility and do experiments. It just doesn't happen anymore. And I would like to emphasize the connection to the user has been broken, and that the whole contract mechanism gets you started much too early with a firm commitment on things that may or may not work out."

VADM DOYLE: "I think another thing that worked was because we worked on things that were of more immediate interest and likely to be solved, and that is the Destroyer Development Group and the Submarine Development Group. I believe we did some very valuable work and experiments that I don't see happening at this point today, except in a more grandiose fashion."

DR. COLVARD: "Wasn't the rigor and the engineering discipline of prototyping and testing important? To me, that was one of the real keys: the fact that we had the proximity of the lab and the range together, where you went from the thinking to the doing in a continuous process. And we did it with some rigor.

"We were talking at lunch about giving somebody an award for having failed. Alan made the point that he was hired to be the director of NRL and a recognized, accomplished director, I might add from being in charge of a project that had abysmally failed. Is there a value to scientifically documenting, in a rigorous fashion, even failure?"

MR. HAWES: "Absolutely. It's part of engineering. We got to be very good at it."

VADM McCARTHY: "Lessons learned are terribly important. The problem we have today is we never look at lessons learned, and it costs us a bucket of money every time we do a thing."

RADM MEYER: "Well, it seems to me that you speak of things we can't solve. And nevertheless, there is one that we cannot solve. We can't, although we could influence, and we should not diminish, I believe, our possible ability to influence. And it came out of these fellows this morning. And it's something like this: The relative straightforwardness or simplicity of the organizational structure that existed in the Navy started in Washington D.C, and radiated downward.

"You know, I pity these poor SOB's today. I just don't know how they do anything. They're so headless. I call them the homeless over in the Pentagon. They're just people wandering around, and there's no way to execute them. And in the Goldwater-Nichols structure, if you don't want to take an order, you just go off and do whatever you want to do.

"Everything has to be done in some consensus, which is how such things as IPT's formed, and all these things, in an effort to find coalition. I had put down in my notes that what's come out of our discussion which did not exist in our time are these kind of words: 'reinvention', 'revolution', 'reformation', 'transformation',

'innovation', 'breakthrough' -- all these expressions instead of work, in lieu of work.

"And today we're searching for the ultimate and the absolute solution: everything we want to do. This cockamamie 'network centric' nonsense. Take the DD-21: we've got an astronomical thing created here, a multibillion-dollar monster, which won't ever get achieved in our lifetime. In the era about which we're speaking, we didn't look for final solutions, ultimate solutions. And as Walt said earlier, occasionally an event of such momentum occurs that it changes things; otherwise, it's kind of plug, plug, plug. I mean, read the book 'SIDEWINDER' It's plugging. It's plug, plug, plug, plug, plug."

VADM McCARTHY: "The question, and it's the question that kind of underlies this whole thing, that Kossiakoff asked us, is what are you going to do next? You know, what's the next step? We have an opportunity. You've got Gordon England just coming in. He's looking around. They want to change something. They want to change the way they do business. Why don't we start categorizing, put the stuff in buckets here. Put it together as a thought piece and take it in there.

"I mean, there are plenty of people in this room who have access to Gordon England. We could come up with a report out of this group over the next three to four weeks that goes into the Secretariat that could be useful, if we could get some of the emotion out of it."

DR. COLVARD: "Well, if the experience from the era is captured sufficiently well. And that's why I keep steering us back from agonizing over today's problems. A lot of people agonize. It's not that we can't affect it or have an impact. We can have an impact, in my opinion, by clearly defining with tight reasoning why things were. Why did that simple system work? If I ask Admiral Meyer, what were the keys to your success as Program Manager? You clearly were successful. Was it just the passion and your drive? That was a part of it. Was it your political astuteness? That was a part of it. Was it your meanness? That was a part of it. Was it your technical credibility?"

"If you were to reflect on being a very successful Program Manager and had to state, what was it that really made that work? Was it good coalition? You talked about this, building a team."

DR. LaBERGE: "I'll tell you how I view Wayne. He was willing to bet his career on doing the thing right. If the system didn't want to do it his way, he was willing to chuck it. And I don't see that sort of commitment today."

RADM MEYER: "I don't, either. It is not there. You're right."

MR. HAWES: "And from an industrial perspective, there are many reasons for success. But let me talk about one that's unique with AEGIS and PMS-400, when Meyer was there: he, more than any Program Manager that my people worked with, knew how to motivate and reward the industrial segment of his enterprise. And it was not through 'write a strict contract and then hold their feet to the fire.' He knew how to interact at the senior level, at the General Manager, Program Manager level, right on down to the floor, and he took the time to do so. So the issue of motivation and reward, some of which was highly psychic reward, as well as at the General-Manager level earnings called the award fee, as an example. He knew how to do that more than any other Program Manager. He was unique in that regard. So that's one of the things that if you want to talk about it, the lessons learned, that's a lesson learned."

DR. LaBERGE: "But there were people who were actually sitting in the system who were willing to let him get away with that. I don't see any protectors of people."

VADM DOYLE: "Well, in addition to the organization structure, it was also true that decisions could be made quickly. And you had people, CNO's, willing to make decisions, rather than ask for another study. He was prepared to make decision, and there was no layering up there that inhibited you; getting right to the issue and making a decision. And I think that was very, very helpful. Critical."

MR. HAWES: "Well, critical was the word because when RADM Meyer left a program review at Pomona, which usually had the entire community there from the standpoint of communication and team building, we all knew that if he made a decision one way, we weren't going to get a week later or a day later or a month later a reversal or a change in that decision. If he had a problem making it stick, that was his problem. He was going to do it. But we could go off and get the work done. And our program management people knew that. And believe me, that takes away all this standing around, wringing the hands, wondering when the next change is going to be. Everyone was working to get the job done."

RADM MEYER: "There's another important factor, I believe, in your wrap-up, and I opened my dissertation with it this morning and it was the cruise missile. Ike Kidd was paranoid. We knew there was a serious problem in the United States Navy, that it had to be assaulted on a very, very broad front, and that no one had the single-point solution, which we search for today on every problem -- some single-point universal [solution]. It was there. It kept us going. And today I think that this generation has to search for what is that, what is it? Now, I, personally, know what it is, but it's apparent to me that this generation does not believe it, nor for that matter, part of our society. And I happen to believe in it's the ballistic missile. But that's my own opinion. Someone mentioned earlier, what is the threat? Well, I don't know. We can sit here until August writing

dissertations right now on the threat. We do not have that focus, Walter, that even in the paranoia of that era caused us, by this time of the day, every day, to be in a frenzy."

DR. DePOY: "Well, it was the same when we had POLARIS, back thirty years before that, only the difference there, it seemed to me, was that OpNav and all these decision maker offices were much smaller. They've all expanded. The guy that made most of the decisions in OpNav on POLARIS was a Commander who later got passed over for Captain. In the fifties, he was running that show from the OpNav point of view because it was small, a much smaller place. But we had that drive in POLARIS that you had and fortunately had good people then."

MR. HAWES: "I've got one more principle that I think came out in a number of discussions. That's this issue of all of the agencies and organizations having a pretty clearly defined role. They knew role that they were expected to play and they generally adhered to it. With the change in the infrastructure, with the downsizing of the defense industry, the roles and missions of the various agencies are very unclear."

Now, it may not have been at the time, but I'm saying compared to today, and that was important from the standpoint of the working relationships that evolved between the various elements and agencies. That ebbed and flowed a lot, as I've tried to indicate by the strength of the Program Manager. But by the same token, compared to today, it was a relatively well-defined situation. You don't have that now.

DR. COLVARD: "I hear us saying that there was a clarity of focus around what the problem was we were dealing with. There was an incentivizing understanding of defense against certain things, there was a real problem, and it was our responsibility to deal with it. There were simpler organizations and more direct lines of communication and the speed with which decisions got made, and there was competent leadership at levels where organizations were successful. And there was technical competence."

DR. BERMAN: "There were clearer responsibilities."

DR. COLVARD: "So you're saying that there were simpler organizations and the pieces knew their role more clearly and played them."

DR. BERMAN: "Your job description was defined clearly."

DR. COLVARD: "So the fundamental principles are simplicity of the institutional structure, clarity of roles, swiftness with which decisions could be made, effectiveness of the competence of the leadership, and technical competence at all levels. What else?"

DR. LABERGE: "I believe this issue with DARPA is fundamental. The Navy used to use its discretionary money for the things it thought were important. And the laboratories and the program offices developed a relationship with industry for the technologies they thought they needed. DARPA now goes to the industry directly, and the relationship to the Service user, is very, very tenuous compared to what it used to be before.

It's clear that the technology is being developed by DOD and not by the Services. And there's a big disconnect, I believe, in how that flows into the using agencies. There is no requirement on DARPA's part that anybody use anything, despite what they say. And one of the things that I would believe they know how to do is go in and say, 'You're out of your gourd putting another half billion dollars into DARPA.' Fix the system, if you don't like it, don't fool around with it."

DR. COLVARD: "I don't want us trying to fix DARPA."

DR. LaBERGE: "I'm saying the discretionary money has gone away in part because it flows to through a different pipe."

DR. COLVARD: "The important point is that one of the reasons we believe it was a successful period was that there existed, down at the execution end, discretionary money, and decision making by the agency that was going to be involved."

DR. BERMAN: "There was also essentially some institutional funding, the extreme case being NRL, but most of the NAVMAT labs did have what amounted to institutional funding. It was not as big as it should have been, but it did exist. With the possible exception of NRL, most of that has gone away. For instance, even at a little place like CNA they used to have a pot of money. Now, every single individual's time has got to be assigned to a project, down to the tenth of an hour. I think it's a point of stupidity, but that's the way it is."

MR. HAWES: "We're dealing around the edges of what I think is a broader issue. And that is, in that earlier era the business economics were pretty well understood. I touched a little bit on it from the standpoint of the IR&D and B&P investment and the returns, et cetera. I'm going to propose that right now the business environment, with the collapse, if you wish, of the aerospace-defense industry down to a very few, the competition within the laboratories and the disappearance of what used to be expectations of where you got your money. The business model for the companies is totally different. Now, the Navy needs to understand what that is, if they are going to have any impact whatsoever on interfacing with the companies. And I don't think they understand it."

VADM McCARTHY: "They don't!"

MR. HAWES: "And I don't know of anyone who has studied it."

DR. LaBERGE: "Surely, it isn't a subject in the schooling that the people get."

MR. HAWES: "Absolutely. I'm sure it isn't in the schooling.

"Until John Lehman came along, I knew what the business expectations were. I knew what kind of return that I could guarantee from our Chairman over a period of time. I knew where the money was coming from to do independent research and development work and pursue the business for the government. The business economics were pretty well understood. And they were pretty well understood from about 1950 to Lehman, in the early '80s. Since the early '80s, the last twenty years, that has fundamentally changed."

VADM McCARTHY:" I think there is recognition that it has changed. At least there's recognition on the industry's part. There may not be that much recognition on the Navy's part. The issue is: what the devil are we going to do about it? How do you move forward? What's the road ahead?"

MR. HAWES: "Well, industry has made up its mind as to what it is going to do."

VADM McCARTHY: "Exactly right."

MR. HAWES: "You just get your hand in your pocketbook and we'll get to it."

DR. COLVARD: "We are an historical society, not a problem solving society."

MR. HAWES: "The point being the business environment was very important."

DR. COLVARD: "I'm not arguing with that. I agree with that. It's understandable."

DR. LaBERGE: "Under the conditions of the Korean War and the Vietnam War, you essentially evolved out of what you were. And management was sort of focused on how you evolved. Today, we're in a position where one is talking about 'leap forward', which is completely misunderstood because most people think you've got to go from where you are. So not only are the initial resources going up to a different pipe, but the pipe is going away from where the mainstream Navy is going."

DR. COLVARD: "Let me, for the sake of argument and discussion, postulate an historical view of the institutional flow of the business. Not to solve it; I don't know how to solve it; I'm not going to be around to solve it. If you look at this country, we developed during the Cold War a critical change in our character. We developed for the first time a munitions industry that is part of our economic base, that's totally dependent upon the defense business, both the domestic and the export side of it. Previously, we were a militia nation that fought, won the

war, went back to business, started making cars again, and stopped making tanks.

"Now, as Ralph said this morning, we were privileged because we were fundamentally oriented in the defense business. GD was unique, and you even cited the fact that other organizations didn't have that history. That the Philcos made car radios as well as SIDEWINDERs. My point is that today's political reality is that the industrial base of this country has become a munitions-dependent industrial base in the high-tech arena as a significant portion of our economy. Therefore, it has become a political entity, as well as a technical and military entity. That's a reality.

"Look at the internal structure of the Navy: the shore establishment has evolved over the last forty years from a militarily-controlled set of institutions, to an institution that is politically-based. Previously, the quality of those institutions was the result of the trained leadership that continually cycled through the system. Today, their quality will depend on the occasional passing-through of a superior political appointee. And the dwell time is going to be short.

"We talked this morning about the fact that one of the big influencing factors was continuity and tenure. The Navy has evolved in its institutions to where ONR has become a Systems Command involved in solving today's problems. It was never developed for that. It was developed to head off the establishment of the National Science Foundation so that the Navy would retain control over research money before Vannevar Bush got around to creating NSF after he whipped down Senator Kilgore, and the Navy was smart enough to get a lead. And its investment focus was on basic research, the utility of which was postulated to be in the interest of the Navy, but the application of which was as yet unknown.

"We now have gotten to where we have started populating ONR with line officers because we wanted to make it coherent with the Navy's needs and to solve today's problems, which means you we've lost our research institution and gained an unneeded technical Systems Command. NRL has become a full-spectrum laboratory that is as focused on immediate products as it is the demonstration of credibility or the permissiveness of the laws of physics. The full-spectrum laboratories have become in-service engineering activities, and the in-service engineering activities are in the process of being contracted out.

"Is that good or bad? I'm not arguing one way or the other. What I'm saying is that's my view of the way the world has changed. DARPA has become an undirected ONR of the Defense Department, with a lot of money for which there is no accountability and not an ultimate Service user. The Systems Commands have become anachronisms that are a diminished shell of their previous incarnations in 1842 as Bureaus. They have evolved through a set of cycles beginning in 1966 when they became Systems Commands, to today, where even

though they have the same name they do not have the money, they do not have control over the projects."

VADM McCARTHY: "The question is, having heard all this and added all this back and forth, what are we going to do with all this?"

DR. COLVARD: "We don't want to solve that problem. The thrust of this round-table discussion was to try to capture something that is totally invaluable. Once we've captured that, we are going to make it available. I am not going to mount a charge to solve the world's problems."

VADM McCARTHY: "I didn't ask you to mount a charge to solve the world's problems. Putting all this stuff together in a pamphlet and sticking it in a comer, it seems to me, doesn't really do much good."

DR. COLVARD: "We'll have about eight hours of tape so that people can look at your ideas. What I'm trying to do is get people to lay out their thinking that might be useful to somebody else. We're not jumping in the parachute we're telling people how to pack. Let somebody who is going to jump pack that sucker."

RADM MEYER: "I would add two points to your very fine summation. The first is that time is growing very short. Like the veterans of World War II who are disappearing at a thousand a day, we who functioned pre-Goldwater-Nichols are rapidly leaving the scene. There are no Officers, civil servants, or even political appointees who any longer grasp what it one time might have been. Coupled with that is a point my associate, Bob Gray, has always been trying to lay on me in recent times. And it is that you are a child when you think you are novel. But you ain't. You ain't the first child born, and you ain't the last child born. But all little children, your grandchildren, believe that they are novel and that there is no yesterday. There was no yesterday; it all started this morning. And it's reflected in this generation's code and the behavior of people with these words that I read off: reinvention, revolution, reformation, transformation, innovation, breakthrough and such.

"Someone mentioned earlier today, well, it's not only these political appointees, it's Officers who have also failed. Well, we can all sit here and name several who are on the contemporary scene, who are guilty of trying to turn our people into as though everything is novel, as though no one did a single thing for the last seventy-five years. Up until this morning nothing has been done, and now it's all on in my back.

"When you started hearing revolutions, network centric and this kind of behavior pattern, or, 'Let's revolutionize the aircraft carrier.' Here's an example I've got right here in my folder. One of the finest essays I've ever read by a couple of people in the alumni magazine of MIT, who researched the aircraft carrier NIMITZ, trying to understand it and explain how it even works. And the truth is

there is no good explanation, except we know there are a lot of injured and dead and material lost over nearly a century of how we got here today.

"Someone mentioned fragility. We have between five and six thousand people in this hundred-thousand-ton airfield. And it functions as we sit here. Day and night all over this globe, it is a very fragile thing. Now, some jerk has come along and said we're going to redo the aircraft carrier, and by the way, it's going to take fifteen hundred men off it. We'll take fifteen hundred people off it. Fifteen hundred people! It's as though we started this morning with no empirical data, no evidence whatsoever of the efficacy of what some think is a very noble undertaking. Or a ninety-five-man destroyer. How much is the destroyer going to displace? Well, wait a minute. We're going to let industry tell us what the displacement is. So it's all new. Surely, back to Paul's point, we could think about how to break that syndrome. Is there a contribution that we old people can make to break that syndrome?"

DR. COLVARD: "I don't have any trouble with the desire to solve the problem. What I'm trying to say is that part of the solving the problem is adequately reporting a very perishable commodity of an understanding of why things worked the way they did. Because just like each person thinks they're the only one born, they also think they are responsible for solving every problem."

VADM McCARTHY: "You know, Ralph has brought up what I think is a very excellent problem. You can't go back. What was good in the past and that sort of thing was good in the past and was great in the past. It's not going to be great today. The world has changed. We've got to figure out a way to go forward with the world as it exists and how to make the imperfect system more perfect. Not perfect. But more perfect."

DR. COLVARD: "What I'm arguing is that the person who may be able to understand the reality of today's problems is the person to solve them. Part of his or her database may well be a properly articulated set of understandings from the past. I'm not trying to solve today's problems with the past. When Admiral Meyer came into town as a Commander, he acted as if he were an Admiral. But he was not oblivious to history."

RADM MEYER: "I was novel."

DR. COLVARD: "There are people around today who have some fire who want to solve the problems. They don't have some of the understanding, the depth of understanding, that I think people sitting in this room do, about how you solve complex problems in the world of research, development, and acquisition?"

VADM DOYLE: "In your summation did you include the downplaying of the role of the CNO?"

DR. COLVARD: "No, I didn't, because I didn't want to offend you three-stars. But the CNO is in charge now of recruiting, training, and equipping."

VADM DOYLE: "If you read Goldwater-Nichols and the Defense Management Report, there's one hook in there that, in my opinion, the CNO, has not used the way he can. It is stated in there that the CNO determines requirements. And I don't think he has used that to the full extent of the law."

DR. BERMAN: "As I recall, in the days when I was responsible for trying to do something, whatever it may have been, I found that the constraints that I was struggling against to be very onerous. I thought the system was screwed up, everybody did, and if you triumphed, it was that you triumphed over the adversity of the system, whatever innane requirements there were to contracting, to testing requirements, to personnel limitations, to cost limitations.

"We all struggled with a large series of boundary conditions that were very difficult. The cost of those systems was considered onerous. You made changes that may possibly be more onerous or possibly less. I mean, the labs had some sort of institutional funding once, and as a result, they were accused of becoming moribund, not competitive, and so on.

"They then went to another system whereby they essentially became contractors living entirely by their wits and salesmanship and view graphs. The question that I am not clear on is: Is it inherently more difficult today or less likely to produce something today than under the peculiar set of the problems of the past? Not living in today in an operational sense, I can't make a conclusion that it is any worse. It impresses me we can bad-mouth John Lehman for the things he did that were pretty bad, but they have tended to be irreversible for twenty years now. And there have been a lot of people that have lived through it and have accepted it because they represent what is considered contemporary management philosophy in our government and in industry. I mean, it is not all that clear to me that the situation is any more broken today than it was in 1965."

DR. COLVARD: "What I'm saying is, that's really not a judgment for us to make. What we can leave is a clear description of the reality of our time and someone else can say, 'My God!'."

DR. BERMAN: " We can leave a description of what it took for something to be successful in the boundary conditions we worked under."

DR. COLVARD: "I agree. And I would also agree that when you look back, things look simpler because you survived them."

DR. BERMAN: "If I could solve the problem, there's no problem."

DR. LaBERGE: "I believe, Alan, that pragmatically you can say a bunch of things came out in the period between 1960 and 1980 that far exceed what's come out in the period between 1980 and 2000; that the system is broken, just looking at the output of the system.

"However, to retum to 'what's different', I think a fundamental difference is that the Navy much more ran its business, and, therefore, the institutions that worked undemeath it were comfortable with their masters than the situation today. The Department of Defense doesn't any longer oversee three Services. It, in fact, is a fourth development group essentially defining how warfare is going to be fought, with Andy Marshall, and finding how you implement it through DARPA. And, therefore, the free resources to experiment are being defined by somebody other than the Navy today. Whereas in our day, the Navy pretty much controlled how it spent its own money."

DR. DePOY: "I told the Admiral the chairman deputized me. I guess we can get back to our conversation of yesterday, our discussion, of the things that have changed. Paul tells a story. When McDonnell-Douglas got the requirements for the F/A-18 E&F, they were so lacking, there was so little detail, so little information. He went back to Washington. This was soon after he got there. He was the Vice President for Engineering. And the Navy sent a team of officers out to McDonnell-Douglas for, as I recall, six months, to sit with the contractor and try to develop the detailed requirements. And it's a point I've heard Wayne make many times, that there's no one in a lot of areas that can write requirements, at least the technical requirements. So, basically, McDonnell-Douglas ended up leading the development, which since most people think of that as a gold-plated airplane raises a lot of issues. But he didn't get a chance, we didn't give him a chance, really, to talk about that.

"Last November, I was telling Wayne, I was in a symposium in Washington, at which J.D. Williams was present. And apparently he's saying this in testimony and elsewhere, that if we decide to go to a ballistic missile defense ship, the Navy can put it to sea in three years. So I called Wayne, or I saw him the next morning, I guess, and asked him about that. And what did you estimate, eleven years?"

RADM MEYER: "Well, statistically if you look at shipbuilding through time, you find that in modern times I'm not going back to 1800s but since, say, World War II, it's around 17 years from conception until the ship is in service. And LPD-17, I think if you examined its pedigree, it's right on track. Seventeen years.

The point is, if you're going to get that done, it takes a commitment. And I've had this warm discussion with all the young service brothers and with Admiral Mike Mullin, who, by the way, is returning within a month to be OP-08. And I've tried to say to them, 'Look. I've got my opinion on DD-21. But my opinion on DD-21 doesn't matter. But what does matter is this: If you want DD-21 in your Navy,

you're never going to get there on the highway you're on, in my judgment. Because the number one issue is there's no one who gives a rat's toenail whether you do get there.'

"Incredible things have become changes of command these days, passing of colors, and God knows what else. So we're changing out officers again in DD-21, here, in a few days. They've been already changed out once. It is a passing-through-station-type thing."

DR. LaBERGE: "Yeah, and your advanced development people are off saying you don't want that, but you want some whole new gaggle of net-centric and whatnots, small ships and, you know, you're essentially undercutting yourself, both inside and outside."

RADM MEYER: "You got it. You are right."

MR. HAWES: "Well, where is there any since of urgency to get anything to the fleet? When you look at the Congress or you look at the people that operate in the DARPA environment or even the industrial environment, what is the payoff to any of them of getting something to the fleet that's useful? What's useful to them is playing with the toys. I just don't see the sense of urgency."

RADM MEYER: "There is merit, as we've always agreed, that you need people running things that have some vested interest, or some interest, in the outcome."

DR. LaBERGE: "The DARPA structure directs it. Continuity directs it. Congress is driven to make their own decisions because you or somebody else comes back saying we ought to do something different."

RADM MEYER: "Exactly. Exactly. And in the end, the Congress is only as good as we are. In the end, they fuss and fume and carry on and they have democratic debates. But in the end, they are only as good as what we're telling them. If we give them very complex, mixed up stories they can't grasp, they can't understand. If we talk about leap-ahead technology and all kinds then they can't deal with it because they can only devote five minutes to what you've spent ten years in."

DR. LaBERGE: "You know, if they sensibly see revolution as meaning somebody is going to come in for a bill for about a hundred ships. There's no way you can pay for that."

MR. HAWES: "There's no sense of urgency on any program that I'm aware of. I admit that that's based on limited information."

DR. LaBERGE: "Isn't it us, Ralph, that is doing it?"

MR. HAWES: "It's not only the Navy, I think it's within the country. Because you have no pull of the Russian Bear. We've can't really quantify what the threat is. We've got the most powerful Navy, Army, Air Force in the world with the highest level of technology that exists. The Soviet Union not being a threat, where do you need all this stuff? What's the urgency of getting a new system out there or a new capability out there? It's just not there. And people do not perceive the threat of the tactical ballistic missile. So why should it surprise us that there's no sense of urgency?"

DR. LaBERGE: "I believe it was nutty, but in my day in the Pentagon the Teller's came in and essentially sold a bunch of claptrap and there was, in fact, a commitment of that administration to go do Star Wars.

"And I'm not sure you even needed it. But at least there was a set of guys who were lined up saying, 'Hey, we want to do this.' I don't see us taking the first step, which is to say what do we really need now and how are we going to get there? Is DD-21 a step on where we're going or not? If it is a step, you better well have it."

RADM MEYER: "Right. That's a seminal question. And, you know, we could put that question up on the bulkhead, and I believe the answer would come out 'no'."

DR. LaBERGE: "What we need is a CNO and a Secretary to say, 'This is what we want.' And start the process going. And new administrations are ideal for this. I mean, the Navy's got a real chance now because it's clear that you can't do what Rumsfeld really wants to you. You are going to have to evolve this thing, and some of you have got a plan that's got a chance of actually getting it to happen."

MR. HAWES: "I agree with that. There is an opportunity. That window may be open only a short time, however."

RADM MEYER: "Right. I implied yesterday that there's this significant change that's occurred, in my view, that if the Navy's got the wisdom to seize it, it's important. And it is the appointment of these three Secretaries.

"I have to go back to when I was a very young man when there were three Secretaries appointed with the pedigree these Secretaries have. It is true that two of them are retired, but all three of these Secretaries have not only come from a line structure, having served in a line structure, but they are contemporary. They literally retired as they moved to this post. So they are today's people, not yesterday's people. And they have run big things. I can't imagine them become ceremonial, as has happened recently. These Secretaries aren't going to operate that way."

DR. LaBERGE: "How they operate, though, is scary, in my mind, if they gang up and decide to go do what Rumsfeld wants, and if that isn't something useful for the Navy, then we've got a problem. Because they're much more capable of making things happen than some of the rest that you can slow roll."

RADM MEYER: "You're right. That's exactly right."

DR. LaBERGE: "It seems to me relative to different points of view, that the kids here need to understand the analogy that is most applicable is sort of being guest conductor at an orchestra. When you really look at it, you don't own anything without the cooperation of the people you're asking to make happen. The oboe will play the oboe your way only if he wants to play it your way.

"And so you end up with a structure that you don't own in the way that you own a gun battery that you may have come from commanding. That you really got to learn a technique of using assets that you don't command but you, in fact, have to incentivize and reward, rather than command."

MR. HAWES: "That's an interesting analogy. There's another analogy. For those of us that have been in line positions, let's say in industry, and I'm just using my example, to go out and now take on a major responsibility in a not-for-profit, where everything is on a voluntary basis. How you manage and how you motivate that environment is totally different than what I came out of when I was in an industrial environment when I said something, people followed orders. And in a volunteer organization, they do not. And there's a little bit of analogy to what a Program Manager has today within the services. He does not have the levers, apparently, that he used to have. So the question is: How do you then manage, coerce, reward, steer to get something done?"

DR. LaBERGE: "I think what we had was a bunch of military people who felt comfortable working with their industrial counterparts in the olden days. Now the thing it's much more isolated, in my mind. I was saying, as a junior engineer I knew more senior Admirals from having briefed them on SIDEWINDER than most of these people will ever see in their lives. And there was a willingness on the senior management of the Navy to come out and work with the civilian complement that, I think, has greatly disappeared, partly because of the acquisition corps isolating a senior management from his association. And they really need to understand they don't own anything other than the opportunity to lead."

RADM MEYER: "I'd like to pull that thread a little. I don't want to dispute Ralph, but I believe he is attributing some great aura or power or authority to Program Managers of yesterday that is, as I recall, wasn't exactly true. And I've always had two favorite sayings in Washington D.C., and you've heard me say them. There's two things in Washington D.C. nobody gives away. One is authority and

the other is money. You have to take them both. I mean, it takes an assault to get both.

"And I wish that we were teaching a course to these officers, teaching the very thing you have just espoused. Because I tried to teach the officers. Naval officers, generally, some intuitive feel for leadership all the way through grade school and such. And then they're raised at-sea, trained in the discipline process to command, to order, to issue. You go to command a ship, and there's a certain amount of homogeneity in that command. You go into the ship, the mess cook, the head cleaners, everybody in the ship knows what the protocol is. Everybody. Everybody knows the Captain runs things and the Executive Officer executes and so forth all way down through. You move into project management, and that's not true. It is not true. You don't have such a neat protocol."

DR. LaBERGE: "And value system changes. What's important to one is not important to the other. "

RADM MEYER: "So, now, the challenge of leadership is the very thing you just said. None of these people work for you. So you're confronted with a challenge of getting the laboratories, civilians, the production lines, the factories, study groups, everybody to play in this grand symphony in this orchestra, and playing for just for more than thirty seconds.

"That is a bona fide leadership challenge. So effective project management starts with that. Starts with that. The fundamentals of leadership. Certainly, you know, conductors have to master that or, in fact, they don't last very long. They can be temperamental, misbehave, and react, but in the end if they're too much, they're gone."

DR. BERMAN: "The successful projects have always struck me as those where everyone who's involved from industrial groups or in-house groups and so on, basically understands that their loyalty is to the project, not particularly to the organization. In other words, people at various labs I've been associated with really could care very little about the parent organization that issued their paycheck. What they cared about was who controlled funding and its prospects and the prospects for success of that job. And the real test of leadership is to make an acquisition project function kind of like a ship, where a person is inherently loyal to the captain and understands their relationship in the project. And that transition is remarkably hard to achieve."

DR. LaBERGE: "Let me slightly disagree with you. I think the real trick is that you have dual loyalties that you have got to somehow figure how you work your way through. I worked for corporations and had to satisfy both my view of doing the project right and also making the company's objectives happen. And the problem that the Program Manager has is understanding my problem so that he can make it so that I can do both of these things at the same time. Because I

never could abandon my company's objectives and stay with the company. The company soon senses that and flings you out. So there is a duality of interest that most of the people in these matrix organizations have. Matrices are by their nature ones where you have dual obligations. The trick is the find your way through that."

RADM MEYER: "People mourn for structure or something to be loyal to. And this matter of dual loyalty, of course, there are a lot of people can't handle that. They can't handle that multi-vibrator nature of jumping loyalty. Many can. But, again, this requires extraordinary leadership. Let me cite an example.

"I'd find I was someplace in the country and I just didn't have Joe's phone number. And so there was conjured up that little wallet card, where the people of AEGIS had phone numbers. At its heyday on the AEGIS project, the maximum I ever had was eighty-six people, and about thirty of those were Officers. Only that small number.

"The world thought that program must have had a thousand people. But the unifier was that little pocket telephone card because everybody who was with AEGIS got a code. You got a code and you got on that little list, and now you were somebody. Well, of course, this could irritate your parent structure if you weren't very careful because every time the boss started looking for you, 'Where's Johnny?' 'Oh, well, he's off on an AEGIS tear.' 'AEGIS is co-opting my people!'

"It's amazing how that really used to irk Rickover. He could never understand how all those people were formulated that way. It mystified me quite often what that little thing meant to people. What it meant to them in a unification process, just having a code."

MR. HAWES: "It's a matter of belonging."

RADM MEYER: "Yeah. Right. They want to belong to something."

DR. BERMAN: "In the past couple of years the programs I've been associated with tend to have been classified. And quite often you just don't let corporate management into these things above a certain level. That guy has got to produce in a bottom-line sense for the company and assure his management of what you are doing is important, will converge and won't end up with a bad name for the company.

"But at that point most of the people below the corporate manager have their loyalty to the project; it's got a code word and that's very often what they say when you ask them what they work for. That's it. And the access codes, and being one of a community or some subgroup within it, is what matters to them."

RADM MEYER: "Well, today we have this obsession with a quarterly bottom line, rapid communication, CNBC, Wall Street, and such. And I think back in his day and my day and, similarly, with Bill Goodwin at RCA. You could go to Dave Lewis, the chairman, and if this was a serious undertaking, Dave could accept, rationalize, a long-term commitment of funds, and accept the static from someplace else. We've created an environment today where CEOs, unless they're really a rarity, cannot deal in that kind of static. They can't deal in a commitment of that nature because the measure is only eighty-nine days along.

"And I've watched people like Kaufman and Burnham and all of those. And I'm sure they're good people. I don't know them very intimately. But I've watched what I see is happening to them every day in running these megalopolises that they have inherited, which don't have a common integral any place in their structure. You look at Raytheon or Lockheed-Martin today. You can't even find a common thread throughout the structure. And that ability to commit that body of people is simply not there in the present environment. And I don't know how to disrupt it."

MR. HAWES: "What the senior level does is that which is in its own best interest. And what Wayne is talking about is at one time, because of the trust factor between the senior levels on a program, whether that program was a TRIDENT or an F-16 or a Standard Missile, as an example. There was a trust factor and there was a longevity factor where they knew they could get a reasonable return on their investment, whether it was time, people, or money. And the Lehman second-source disrupted that. But that trust factor allowed people, like, Dave Lewis to listen and take a risk, if he wished. Today, the whole issue of shareholder value, because of the uncertainty in his environment, gets down to what is the quarterly return? What is it that I go out and talk to the stock analyst about to make sure that they don't clobber my stock? That's where the focus is."

DR. LaBERGE: "That's a whole new kind of senior executive in the company. The T. Wilsons at Boeing have gone away in favor of the Frank Swanson's view of the world.

"You end up with a set of people no longer able to understand you when you talk to them because they're coming from the fact their stock turns over every eighteen months. Lockheed's stock turns over. So you're on a schedule of keeping people satisfied with the next quarterly return. And so these people come from that background, and so the people I used to deal with have essentially gone away in terms of corporate management. So, part of the problem is to find where in the structure you go to where you can get the senior guy to really understand that what you're doing is important."

MR. HAWES: "How do you get some leverage today?"

DR. LaBERGE: "It's not as easy as it used to be."

RADM MEYER: "Let's just take the case of Tucson for a moment. There's some super, superb individuals, leaders, engineers, designers and such there. And the leadership, generally within that, I had a hand at raising and Ralph had a hand at raising.

"And you go today and talk to Jerry Lockhard, and he immediately starts talking about his portfolio, what he has in the plant. 'You've got to understand we've got thirty-two programs in here and every one's of equal importance.' You look at the megalopolis of Raytheon with this huge debt hanging over his head that Burnham inherited. And I tell you, corporate treats that place like a colony. And every month they got to pay their taxes to corporate. And that's their number one objective. There are days I think corporate doesn't give a rat's toenail whether they make Campbell Soup or toilet paper or canned artichokes. All they care about is whether they meet that tax laid on them. And if you meet it this month, we raise it next month. If you meet it then, we'll raise it next. So we just keep raising.

"My point is, it doesn't matter how good those leaders are at Tucson. They can be superb leaders, but they're caught in this cross fire, which they cannot break out of nor escape. This is not good for our nation. And Walt mentioned the whole matter of the arsenal concept yesterday, which I strongly embrace. Because we're being driven to that because these orthogonal measures have shifted so badly within industry related to this mistrust.

"Now, this probably happened before. This may have happened in the teens or in the twenties and explains why there were arsenals before. We've got a group of people today think how stupid they all were and how dumb they were. They created all these monuments and tombs. But it probably occurred another time in the armed forces."

DR. LaBERGE: "I think the point, Wayne, that extends your argument is that the Program Manager really has to understand that the people he's dealing with have these sorts of problems. What used to be an industry that was able to bet on the future, long-term, and reduce profit and early income no longer can do that."

MR. HAWES: "There was a coherency, Walt, that existed that is now chaotic."

DR. LaBERGE: "So you are conducting an orchestra that you don't know or own. And you better well understand what motivates the oboes."

RADM MEYER: "Right, right. Exactly. Or he can really play off key."

DR. COLVARD: "How would you define an arsenal, Walt?"

DR. LaBERGE: "By arsenals, I mean, in any one mission area there is a single group of people who have a locked-up position. It may be a government Program Office and a contractor. It may be a China Lake inventing things. It's TBD. But you don't have enough money to implement the competitive world that we used to have."

DR. COLVARD: "But is one of the characteristics that it is available in perpetuity? That is, the institution of which it is a part decides about its existence or demise as opposed to its own decision?"

DR. LaBERGE: "Obviously, I haven't thought it through. I use the word arsenal because it gets everybody mad in the sense that it's a single thing that everybody unites to hate. They think of it, in part, because somehow or other over the past twenty years there has been a coordinated effort by industry to essentially promulgate the idea that government can't do anything."

RADM MEYER: "Right."

DR. LaBERGE: "And the combination of the PAC's and the influence that they have essentially makes people listen to an argument differently than they would if there wasn't this buying your way into the system. It's compounded by two other major things. That all of your advisory boards essentially have major industrial people on them with no in-house technological participation.

"It turns out the Defense Science Board has a few house Admirals, but with one or two exceptions, no really significant, knowledgeable participation, or parity, in the whole thing. So you get a belief that the government can't do anything, by constant repetition. And, you know, I believe that sometimes the government does well, sometimes it doesn't do well, but it is not anywhere near as anathema as the current cult would have you believe. So I use the arsenal term mostly because everybody sort of revolts at the idea. But it's going to be a noncompetitive environment as Ralph is arguing.

"And that environment will have its way. The people that run the corporations that you used to represent will, in fact, slow roll things until they get motivated in a way to where they want to."

MR. HAWES: "You may credit the industry in the generic term, Walt, with too much cohesiveness."

RADM MEYER: "That's right."

MR. HAWES: "That is the end result. But what's behind that is the issue of growth. And the way in the current environment a company can grow, it's got to go take away from somebody else. So one of the things it does is that it convinces the government, 'God, we can do that a whole lot better and cheaper

than you can. It's called outsourcing. So give me that business and I'll do a better job.' Well, maybe. But that's been the end result."

OBSERVER: "I think the argument to support the arsenal idea that Walt mentioned is an argument that says there is no business in the long-term which meets the competitive uses of capital and that you can, therefore, kind of predict what will happen. Once you've exhausted outsourcing, once you've taken over all those functions, then the thing is it ceases to be an interesting business because there's better places to employ your capital. And at that point you say, 'Well, I'll just quit it. I'll sell it off to somebody and get out of it'. And that's exactly what it is I've seen in the areas where I've worked."

MR. HAWES: "I sent a note to my longtime friend on my left over here. And I think you may remember the note, Wayne. It said: What happens, since the only place the surface Navy today gets weapons is out of Tucson, if Raytheon decides to spin that division off? What happens if Raytheon and the British Aerospace decide to merge or British Aerospace decides to buy it? What happens to the Navy's ability to get its weapons? Now, think about that. Because that's the end result of what you're just talking about.

"Someplace at Tucson is a long-term plan, a business plan, of how they're going to get money out of the work that they're doing. And what kind of return on net assets, or whatever their current measure is, they can meet. And when it gets to the point that they can no longer meet that, not at the division but at the corporate level, then a couple things are going to change. Either they will force the government to give them a higher rate of profit, because they are a monopoly, or the parent company will do what General Motors and a few others said, 'This ain't worth it' and either spin it off, or more likely, go sell it to someone. And if you look at what happened with General Dynamics, that's exactly the decision that was made. The decision was made by the CEO. The way to get the stock price up was to sell off assets. And that's what he did.

"One of the ways if you are in the defense business that you think you can make more money is you start the process of vertically integrating both at the top and at the bottom. When you got a lot of business and you're making a lot of money, I'll tell you, it's the other way. What you start doing is going out to those who can really do it more effectively.

"And so what's happened is we have horizontal, that horizontalness that came about because of the amount of business that was out there to pursue, now everything is moving inward because there is so little business to pursue, and they are going vertically integrated. And that's why you've got the big contests between the giants relative to the systems integration role. Because they perceive that's where there's more money."

DR. LaBERGE: "But relative to our instructions, to think of the past, I think the past was an easier structure to work with, that the jobs that we had in the olden days were easier because you had a different kind of access to the corporations that had different objectives. That you could get people to do what you did then. Now it would be much harder to do. And, therefore, you ought to learn that you can't do it. You've really got to adapt to understanding how to deal with the environment you have currently because I don't think you can change the current environment."

MR. HAWES: "Walt, I agree with you a hundred percent. And I don't think we understand the business environment. I don't think the Navy understands the business environment that exists out there today."

DR. COLVARD: "Are you suggesting we will eventually nationalize the defense industry?"

MR. HAWES: "That's a possibility."

DR. LaBERGE: "No. All I'm saying is, in observing the differences between then and now, there is a major difference in the ability to play this orchestra; that the motivations of the people that you have to deal with have substantially altered."

DR. COLVARD: "All I was saying is, if you define the arsenal as something you cannot afford to be without, therefore, you must have it available to you; therefore, you can't let it go out of business, so you've got to guarantee its existence. And it's critical to you as we did in Sunnyvale in producing rocket motors for POLARIS. You couldn't close that place if you wanted to.

"If we're saying those kinds of things, then what that eventually says is that becomes an inherently critical government function that you must own forever. So between that and nationalizing, to me, is a distinction without a difference."

MR. HAWES: "Maybe you'd only nationalize it, Jim, is if there was some very extreme national threat, which I don't perceive. Then you might nationalize it. What's more likely to happen is the government at some point in time will say, 'Enough is enough'.And they'll go do what they did in the second source. They'll entice somebody else in the business, which will cost them a bundle."

RADM MEYER: "No doubt about it; not only will it cost them a bundle, but they're going to end up with even less ammunition than they now have. And we are in a pathetic situation in the Navy where the realism just can't seem to emerge the crisis we have in ammunition. And this is not fifteen or twenty million-dollar, one-year thing. This is like several billions of dollars. And just this past month in the [Naval Institute] Proceedings, Admiral Fargo had an essay where he points out, and he is the first Admiral I've seen say anything about the shortage of ammunition, that we cross-deck all our ammo and are cross-decking all our

missiles. But the sad part is he just kind of says, 'Well, isn't that the way you've always done it? Don't you always do that?' And Jim brings up the point that two-thirds of our Navy is not overseas. One-third of our Navy is overseas. And then we have one of our Admirals stand up and say, 'Well, yeah. But they're really ready. We've got them all ready'.

"But we've got empty magazines. Two-thirds of the magazines are empty! There's nothing in there. And you cannot find in our Navy, or DOD of course, mobilization is an obscenity that you can't even talk about, anyone who is concemed enough about our readiness to take it on. We have this mythological two-war thing over on the one hand, but there are no real materiel or logistics plans in the base to deal in the mythological two-war thing. And instead, we get the run-around, these little schemas of small-diameter weapons. We will load up the bomb bay of the F-22, and we'll get this extraordinary centimeter-type precision. And then we don't need all those bombs.

"Well, I'll tell you, the TOMAHAWK planning far exceeds the number of TOMAHAWK's available. The Standard Missile planning far exceeds the number of Standard Missiles. Not by a little bit. A great big bit."

VADM DOYLE: "We've lowered the standards for readiness. As a result, we are presenting a picture to the public that misleads them as to our overall requirements across the board when you leave out two-thirds of the ships."

DR. LaBERGE: "Who's at fault for that?"

RADM MEYER: "Don't get me up on my soapbox on Goldwater-Nichols."

DR. LaBERGE: "No, is it Goldwater-Nichols, or is it that with a given amount of money, which we have chosen ourselves to keep the infrastructure, keep the long-range missile, and cut the ammunition?"

MR. HAWES: "When I read what Bush is saying that's exactly what I conclude. If you think you've got an ammunition problem now, just wait, because what he said is we're going to do a lot more R&D and look at the advanced stuff. And the only way they are going to get the money to do that is to not produce anything."

RADM MEYER: "Walt, this structure is so disheveled that I am convinced, this sounds cynical and I hope it's not, but, you know, if the Navy got a $10 billion plus-up tomorrow, it wouldn't matter a rat's toenail. It wouldn't matter a bit. It would just be like taking coal oil out there and pouring it on the lawn. It will just run wherever it's going to run. It won't affect things because there's no fundamental structure to deal in it or to execute. There is no executing structure.

"The point is you cannot find the focal point, when I made my expression to Goldwater-Nichols. We've created an organization like this tabletop. And the

only utilitarian method discovered to work at all in it is these infamous IPT's that have cropped up. So we all sit around the table. Be careful. No one's in charge. And hopefully when we all get up and leave the room, somehow we're all going to magically do the right thing. That's an IPT."

DR. LaBERGE: "Let me have at you. Granted, Goldwater-Nichols may have some warts, but it created a role for the Joint Chiefs, which they have never executed. You know, if you ask who could stand up and say something is absolutely asinine, silly. If the Chairman of the Joint Chiefs backed up by the Chiefs said that, the Congress, I believe, would listen. I don't see a mechanism within our institution for getting that priority.

"You've got to be willing to retire, I believe, on the issue of which way things ought to go. It's just sort of saying it one day and then going back to work."

RADM MEYER: "My point is the structure cannot execute, is my point. It cannot execute.

"I don't know how revealing General Clark's book is. I've sent for it. The write-ups were pretty frightening. The things Clark has said about the conduct of the war and the command-and-control structure he was trying to impedance-match with people like Cohen and Shelton and such.

"I think in the end it does start there. It does start there. If our military leaders cannot or will not throw it on the table to the American public, then the rest doesn't matter too much. And as Jim pointed out, you can read the testimony. I mean, it is a testimony where all of it is a little hand wringing. It's getting awfully hard. We're having a little trouble getting it done. But no one has pounded on the table and said enough of this. We're not going to sail. We can't sail. No one's done that."

MR. HAWES: "Politically, that's suicide."

DR. LaBERGE: "Back to Jim's point, our focus shouldn't be on solving the problems but only identifying the differences. Let me try one other difference. In the olden days there were a set of Red Teams that were formally set up that existed that sort of tested credibility. I don't see any substantial change. Systems Analysis in the Air Force reported to the Chief of Staff in the old days. And the three-star that ran it was next to God because if you didn't get him to agree, the Chief wouldn't let your program go.

"The Army had an organization that was there to do testing of things. I don't know what the Navy had, but it had a bunch of rascals at the laboratories that could stand up and yell. I don't see the system having any checks and balances. And in the current Army nuttiness, which in simple form is that you'll restrict

yourself for the rest of your life by the dimensions of the C-130 as it exists, even though the vehicle doesn't stay in the C-130 all its life.

"You have people allowing programs to go forward that are absolutely nutty. That system has decided it's easier to make an evaluation if you say you can have only one weapon system on the vehicle instead of mixing and matching rockets and guns. There is nobody who stands up and says that that is silly. And in the olden days there were some checks and balances where people in authority could tell a Chief that he is doing a dumb thing. And I think we get sloganized, net-centric whatnots, fighting vehicles. Nobody seems to worry whether or not you can engineer a war where a fighting vehicle can have the standoff distances necessary to kill everybody without getting shot at."

DR. COLVARD: "Do you think there was a tolerance for dissent, or was it a question that we had better processing by which we understood objective reality? Because it doesn't matter how good your decision-making machinery is if objective reality isn't really understood, you can't make a correct decision. I thought one of the strengths of the laboratory community, in my day, was that you were fairly free to speak out; you could, as Wildavsky would say, 'speak truth to power'."

DR. LaBERGE: "That's gone away because of the getting rid of industrial funding."

DR. COLVARD: "Well, I guess I'm trying to put my finger on the thing that we lost. I remember going into Ty Marcy's office with C.J. Rorie, having been told when we came in, 'Bring your badges and we will decide at the end of discussion whether you still work for the Navy.' We had refused to take $50 million to put a high-energy laser aboard a ship because all of our knowledge of objective reality said: one, the conversion efficiency is so low that you would have to tow a tanker to fuel it for one shot; two, at atmospheric level, the absorption is so high, you can't transmit; and, three, if you do transmit, all you're going to do is paint the target white and not penetrate it.

"When we told him that we wouldn't take the Navy's money because it defied the laws of physics, he said, 'Don't you understand? The Navy wants that aboard ship.' And we said, 'Don't you understand?' Not quite in those terms, but we said, 'In all due respect, you should put money into research, because we're not there yet.' And to this day, the laws of physics haven't changed, and you don't have a high-energy laser aboard ship."

DR. LaBERGE: "And to this day, the high-energy laser is the weapon of choice at the Newport war games -- it's goofy!"

DR. COLVARD: "But Marcy had the courage later to say in a public meeting, without identifying us, 'Last year I almost fired one of my Technical Directors for

doing exactly what he should have been doing, which is to tell me things I needed to know, even though I didn't want to hear them.' I'm saying in the institutional process that we were a part of, that was one of its value sets, that we were to be responsive but also responsible.

"The point I was trying to stress is that however the institutional set is defined or developed or supported or anything else, there are fundamental functions that must be performed. Somebody must decide, somebody must support, somebody must execute, somebody must review and approve.

"And some of those must always be in the hands of the government. Whether you have an arsenal that's made up of an industry to whom you have made a lifetime commitment because you can't afford to do without them which we've done now in a couple of shipbuilding yards or whether it's a civil service activity or a university laboratory, I don't care about that. I'm not interested. But the inherent functions of understanding, deciding, supporting, executing, and doing must be performed. And some portions of that must be continuously available in a quality fashion to the federal government. You cannot leave it to a market that is driven by the profitability of its operations."

VADM DOYLE: "Can I raise one other? On the issue of dissent, there used to be a rule in the building, and I remember going to a meeting with Harold Brown just before people went over on the Hill to testify on the budget. And he told his political people, 'You have an obligation to state the administration's view on these matters. If you don't, well, send me your papers'.

"On the other hand, the military don't operate under the same rules. If you're military and asked to give your personal and professional opinion, the procedure is, first, to state the administration's position and then to give your personal opinion.

"Well, we then made sure that the right questions would be asked at the right time, of course. I'm not sure whether that rule is still in effect. I know that I had to test that when Forrest Peterson and I testified against Secretary Claytor's plan to fund three conventional aircraft carriers, as opposed to two nuclears.

"And both he and I took a position of opposition to that scheme for lots of reasons. And we initially got into trouble until we pointed out what the ground rules are, were. And I'm not sure that still exists, whether those ground rules exist or whether the system has become so politicized that people won't state their personal views."

MR. HAWES: "I think the latter is what's happened, from my perspective, Jim; it has become so politicized that it doesn't matter because there is no accountability."

DR. LaBERGE: "I honestly don't believe that. I don't think the current set of senior people that testify have a coherent idea what they really believe."

RADM MEYER: "I think that's a correct statement."

DR. LaBERGE: "The system is just in free-fall. And it's encouraged to be that way by the funding system that says if you don't do what we want, we'll fund DARPA to do it and cut your budget. The whole issue of a revolution in military affairs is, in my mind, goofy. It's an evolution; a slower [change in] technology today, in my mind than existed during our time. The transition from vacuum tubes to transistors to integrated circuits was massive. The change to nuclear power was massive. Today, we're sloganizing the business, rather than understanding the issue essentially evolved with a set of priorities where you put your money where you believed your requirements are. The services, in my view have given in to OSD dictating Andy Marshall's way of the future."

DR. COLVARD: "Why didn't the system free-fall in our era? Was it because we had a clearer fit and, therefore, cohesive..."

DR. LaBERGE: "We had a couple of marvelous wars that brought focus. And you had a Russian enemy where you were going to get the crap beat out of you if you sailed up near where he had all his airplanes. So you really had to go figure out what to do."

RADM MEYER: "I think you're close to expressing it. We had a whole population of officers who were either in battle or threatened with battle who had some intimate identification with things material and the significance and importance of them.

"I remember sitting on several selection boards back in that era for Captains and Admirals. And I remember the behavior of the boards, of how the senior officers, particularly the aviators on the board, identified a picture would come up on the screen and one of them would say, 'I know that fellow. That fellow bailed me out over in Subic Bay,' or 'That fellow got those weapons to that ship when I needed them.' They had that identity.

"And there's another part. We had giants in the materiel establishment. Big heavyweights there. And we had this admixture of naval officers that cycled in and out. We had in that era the so-called subspecialty process, which was generated and fueled by the Postgraduate School, by the way, where you may have studied financial management and I may have studied physics and he may have studied fire control. Just think how the world would have been different if that had all occurred that way.

"But the truth is we're Naval officers. And we had this subspecialty. So we moved in and out of that system. And it did a couple things, but of the important

things it constantly refreshed that system and constantly reminded that system, plus the heavies moved in. Today, this fracture is complete. No cross-fertilization goes on at all, thanks to Goldwater-Nichols, so that rapidly the officers, even, are not very well informed. And they certainly don't feel, emotionally, how important getting things to sea or getting them ready are. That has evaporated from the scene. And that decay is a very serious one.

"And, of course, the Postgraduate School has tended to follow suit where all these cockamamie courses and seminars out here have emerged as replacement for so many of the others that I thought was pretty critical, important stuff in another time. And to see the hill to recovery is very difficult for me. The materiel establishment doesn't exist anymore. With this, with this migration, this abandonment of the continent by the Naval Sea Systems Command, the residues of it, have gone to the island of the gun factory, it is the last thing anyplace. You can't find anything. They've disappeared. They're scattered all over the United States. So there's no coherence. We'll never attain.

"They convinced themselves, 'Oh, well. You got to understand, Wayne, we have electronic means now. We've all got beautiful video teleconferencing. Beautiful connectivity. We have e-mail. We can talk and talk and talk and chatter day and night. Chatter, chatter, chatter.' And so, being dispersed doesn't matter. Well, that's nonsense. It does matter."

DR. COLVARD: "They've gone back to where Rear Admiral Dahlgren started as Commander of the first R&D investment in the country, which was the Gun Factory.

"What would cause these giants to reemerge and the coherence to be reestablished? Would an outbreak of a major war? What's the normative reset?

"Let's say for the sake of argument that in our day there was a coherence. There were emerging leaders, or leaders did emerge. And things did get done. And the track record is pretty clear. The technology was turned into sailing systems and flying systems. So there's not much argument there. What is the critical thing that pertained in that day? Was it the fact that we had a focusing external threat that caused us to have a clarity and singularity of view? What was it?

"Admiral Meyer made a point last night as we were breaking up, that we always think we're the only ones. And I'm asking, are we having selective recall that, as Berman pointed out as we were leaving, 'Well, actually, things didn't run all that well when I was down there. I had plenty of problems'."

DR. LaBERGE: "But think of all the things that have happened in terms of systems that have been aboard a ship. The ships are different from the ones that ended up World War I, to the ones that exist now. A whole bunch of good

things happened very early to make this happen. I don't see this same sort of multiple set of..."

DR. COLVARD: "But I gave you credit for that. I said let's accept that. Without argument. So we answered Phil's question in the positive. Yes, they were simpler. Yes, we did more."

MR. HAWES: "I think there's three factors. First of all, there was a momentum that we were still operating on out of World War II. And that momentum was caught up in the leadership and their dedication to making sure that they could actually handle something like the Kamikazes. So that momentum was there.

"The second thing is you had the rapid emergence of the Russian Bear and the external threat that allowed the leadership to focus and keep things pretty well in perspective and keep their priorities even though we would argue over it reasonably in focus. And I think those two had an awful lot to do with it.

"There's a third one, in my mind, that we missed that was very important. And was an era when management by objectives, goal orientation, was extremely important. Today, management by objectives has lost out to continuous improvement and process mentality in orientation. There's nothing said about the issue of achieving an objective. If I get the process straight and I check all the boxes, all this will happen the way it ought to. That's nonsense. The purpose of a Program Manager in those days was to get something explicitly done and to the fleet.

"'m not sure that that's the case today. The Program Manager checks off all the boxes, and if a product comes out, maybe that's okay. Those are the three factors that I see different."

DR. COLVARD: "o a good war and a paradigm shift in management would solve our problems?"

DR. DePOY: I'm not sure that momentum was there, because in the late '40s things shut down completely. And then between Korea and Vietnam, we were in pretty dire straits for a lot of the time. In fact, thinking back, the start of Vietnam, the way our systems crashed, we couldn't get a radar working on those ships. And the ammunition was in terrible straits because we were in the process of getting back into the conventional [weapon] business.

"And then by the end of the war, in 1972, I was on a ship with a race riot. I thought the ship was going to be taken over. Everybody locked themselves in their staterooms. And it was down to that level."

RADM MEYER: "Which is what they now do."

MR. HAWES: "Oh, I don't think it's been equal, but you had a lot more momentum, particularly with the draw of the Russian Bear, than you've got right now."

DR. DePOY: "Yes. Oh, absolutely."

RADM MEYER: "Your points are correct, but there's another connector that we have to think in terms of. That era, which Jimmy and I spent at sea, much of it was caused by an unbelievable downsizing. Downsizing in today's sense you couldn't even describe of what's happening just hours, every hour it was downsizing, chaos was occurring.

"It was extraordinarily aggravated by the point that Walt made yesterday, and that was the creation of the Department of Defense in the National Security Act of 1947. One of my old deputies, Doc Daugherty, is repeatedly fond of reminding me that the United States has yet to win a war since the Department of Defense was created. It's never been able, starting with the Korean War, to bring the war to conclusion. It always brings it to a truce.

"The other thing that happened is we had a whole body of Officers, and not an insignificant number of civilians, who had suffered the pains of battle in war in severe operations, who populated our leadership. Plus, our leaders believed the Russians. They came from the feelings of war. I remember my days of sailing. They were every place. They believed that they were there. Today, the CNO is yet to make a single statement on ballistic missile defense. I do not believe that the Chief of Staff of the Air Force has yet made a statement. I don't believe the Commandant has made a statement. The Army, in fact, has not made a statement, except from a battery viewpoint. So these people do not believe. And so the reason we have no threat is those seniors don't believe we have a threat. All of us little peons would believe if they believed."

DR. COLVARD: "Let me make the following argument, and then you 'learned gentlemen', as Ike Kidd would say, can correct me.

"The reason that we don't have coherence is not our leaders but the public. The public felt strongly when they were building fallout shelters and arguing about whether they'd shoot their neighbor if they tried to come in. They felt strongly. The public felt that there was a reality to the threat. It was emphasized by SPUTNIK, when it became demonstrably true that a potential enemy whose intent we felt was not in our best interest, could throw a nuclear warhead intercontinental distances and, therefore, our sovereignty could be threatened without being invaded.

"The whole process of a democracy is political. I would argue that the thing that differentiated our time from today was, there was clear public support for and,

therefore, it was easy for the leaders to deal with the idea of investment and defense."

DR. LaBERGE: "I've got a current example that says you're wrong."

DR. COLVARD: "Okay."

DR. LaBERGE: "It's the whole ballistic-missile defense thing that we're about to embark on a national system. You know, the public is sort of indifferent. It's yet to make up its mind. We're about to, unilaterally because a couple of guys believe it embark on picking the Navy's pocket like you have never seen before. And a total amount of money environment, turning on national defense, is going to squeeze down everything else.

"And so our Navy is letting this happen to it. It is not up storming, saying fleet missile defense is the sine qua non of the Navy. You either put it underwater, which you can't do, or you find a way to protect it on the surface. And that's going to dominate what we look like fifty years from now. So what we ought to be doing is working on how we do fleet missile defense, rather than screwing around with Street Fighters and small carriers and things, which essentially say the problem is in the 'too-hard' basket. Or if you say you can't do fleet missile defense, then you ought to turn off a whole bunch of things and change it. We have no sense of what the critical issues are of which, in my mind, that's probably the most critical."

DR. COLVARD: "If there were a defined, credible threat, that focus would be achieved very rapidly."

DR. LaBERGE: "But there isn't one."

DR. COLVARD: "I know there's not. And as a result, you have got Brownian movement on the basis of the idiosyncrasies of personalities."

DR. LaBERGE: "One thing, though, is if a few senior people get together like they are now in DOD, I believe you can force a substantial allocation of money differently. They're going to take and ram more money into DARPA to go make all this work."

DR. COLVARD: "But we have never been able to arm against the unknown. We arm against what we think we know."

DR. LaBERGE: "My goodness. We are not going to utilize the monies we've got because of a flow towards a very hard-to-implement problem which, in my view, we're not exactly sure we know how to make it work when there are a bunch of things that, I believe, we could be doing, in part because we're letting everybody

get away with it. There aren't the old curmudgeons in the system there used to be."

MR. HAWES: "And along that point, let's take and I'm talking about the old curmudgeon so let's just suppose. Who cares whether Raytheon/Tucson, is over budget and behind schedule on every one of your weapons programs, Mr. Navy? Who cares? There's no curmudgeon that I can find that thinks it's important or cares."

DR. LaBERGE: "You really don't want to find out, because that's going to get the Congress on your back."

RADM MEYER: "You don't want to know. You're right."

DR. LaBERGE: "But it used to be people were trained to worry about that sort of thing. And they worried it. Now, they're trained to worry about how you keep things tamped down in the Congress, in my mind. "

DR. COLVARD: "Well, which tells me, again, that you're worried about the political dimension of it, which means how will the people react to it? I'm telling you, when there's a clear and accepted threat, you don't worry about that. You didn't worry about how much World War II cost. You worried about whether or not you could do it."

DR. LaBERGE: "What I said was you can't generate a war."

DR. COLVARD: "I'm not suggesting you do. But I'm saying in a period of peace, the military doesn't know how to behave in peacetime.

"The populace is not dumb. The message you take to them has to have some credibility. And Bush, in my opinion, is going to have a tough time, not because he's Bush, but he's going to have a hard time convincing somebody that there's somebody standing by to threaten your children. If they don't threaten your children, you don't worry about them.

"Navy-wise, we haven't fought an opposed war since World War II. We've fought a whole series of inconclusive and marginally supported wars."

RADM MEYER: "I'm naive. I was born and raised seventy-five years ago in the part of the country that some people certainly would think is unsophisticated and naive. And in the ethos where I come from, people look at their military leaders, their Admirals, their Generals, with great respect. Great pride. And they expect them to be unequivocally honest and straightforward, occasionally, perhaps, drifting off of the righteous or moral path, maybe in their personal behavior. But they have high expectations for their military leaders, as contrasted to their political leaders.

"They tend to always know, 'Well, Joe's kind of a scoundrel, but he's our scoundrel. And he's a nice fellow. And he got us a new courthouse.' And things like that. 'And we got the highway through.' And it's stuff like that. They have kind of a bifurcated code for their leadership. Their political leadership is in this channel; their military leadership is over here.

"So if I go Brunswick, Missouri and I tell the people that the country is in trouble in ballistic missile threats, their first question is: 'Well, nobody's told us. Why aren't you doing something about it?'

"That's their immediate reaction. They're writing out their checkbook. Now, they're not willing to spend more out of their checkbook at the expense of their children or their goldumed trailer and boat or some such. Nevertheless, they look to the military for their safety and security. That's their expectation. They look to them for that.

"Well, if you look at Wesley Clark's book, I think there's a fundamental, subtle thing that happened here. He has made an assault on Cohen and Shelton. So this matter of operating the war has kind of become a business undertaking. Now, Billy Cohen is really loaded with qualifications to run a war. I mean, he's just loaded with them. Here's a guy lifted out of the political channels over here; he isn't even a businessman and moved over here to run a war. So the reason here -- I'm not sure Colvard is totally correct on his point. I don't mean to sound like I'm arguing with him. The people respond to what they believe they're...

"Let's take the ballistic missile. Its critics claim that we've gone through sixty billion dollars and we've got no products. Sixty billion dollars! Well, how did we get it? The only way you get money is that the Congress appropriates money. And they've appropriated a lot of it. And this year they'll appropriate several billions of dollars. So, in fact, there is a thread of belief it's not only scoundrels trying to steal. It varies all over the place, from the far left to the far right. And I am disturbed that our military leaders can't seem to pick up on that and see the seriousness of that. And you know that I have tried to argue at the CNO level and other leadership levels that here is something the public does apparently support."

DR. COLVARD: "Let me close the proceedings with a couple of comments. One, I deeply appreciate everybody coming and trying to dig out of the minds of all of us something that's worth archiving for the future, for people who will be worrying these issues long after we're gone. They will at least have our honest perceptions, not our conclusion or recommendations, but our honest perceptions of what went on in our era."

SYNOPSIS OF PRINCIPAL OBSERVATIONS

The foregoing report presents the presentations of individual attendees at the seminar and the roundtable discussion that followed their presentations. The following is a review of the significant points from the presentations and discussions about which there seemed to be general agreement. Support for each point was not unanimous among the group and attribution is not assigned to issues presented.

- Continuity was a major point in all the discussions. This included continuity of leadership, funding, and focus on the problem being solved or the capability being developed.

- Technical competence, appropriate to the requirements of the role, was viewed as critical at all levels. This was true for Naval Officers, the Civil Service, and University labs, as well as industry.

- The existence of discretionary funds, in the form of IR&IED or B&P in both industry and the government was viewed as critical to the advancement of new technology during the Cold War era.

- Clarity of role among private and public sector institutions and between the policy and execution components of institutions enhanced trust and facilitated strong positive interrelationships.

- Program Managers who were successful had rather similar characteristics. They were extremely focused, they knew the technical details of their program, and were, in effect, their own chief engineers. They developed loyal dedicated contractors, they did not tolerate fools gladly, they remained in the same assignment for many years, they maintained a stable funding flow, and they were persuasive in their presentations.

- There probably never were any "good old days", and no matter what we think, the current acquisition system is very unlikely to revert to the way we did business thirty or forty years ago.

- In all successful programs and institutions, there was an emphasis on results rather than cost, mutual trust, and respect, and a sense of urgency backed up by the courage of convictions.

- The existence of a defined potential enemy created a rather stable funding environment, which reduced the amount of infighting and institutional competition. It may have also contributed to the perceived higher tolerance for failure of that time.

- There was strong uniformed leadership, with rank aligned with responsibility, for those officers who dealt with the OSD and Congress. This was important in the provision of "high cover" for major programs.

- The approach to building AEGIS cruisers and destroyers effected an historical transformation in organization, fleet introduction, shore-based training and infrastructure, land-based prototypes, engineering, manning and billet structure, and new concepts of ship integration and systems engineering. This was due to the tenacity and tenure of both OP-03 and the AEGIS Program Manager.

- The in-house laboratories played an important role as honest brokers and keepers of the technical safety net. Industry worked well with most of the laboratories, but was at times uncomfortable with others. Industry was frustrated by the perceived lack of ability to hold an in-house laboratory accountable.

- The best leaders, in both industry and government, were those who were rotated through both experiential and educational assignments such that they developed an understanding of the Navy and industry from a corporate sense.

- One follow-on meeting of the group is planned to reflect on the original meeting and add any thoughts that were not covered then.

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